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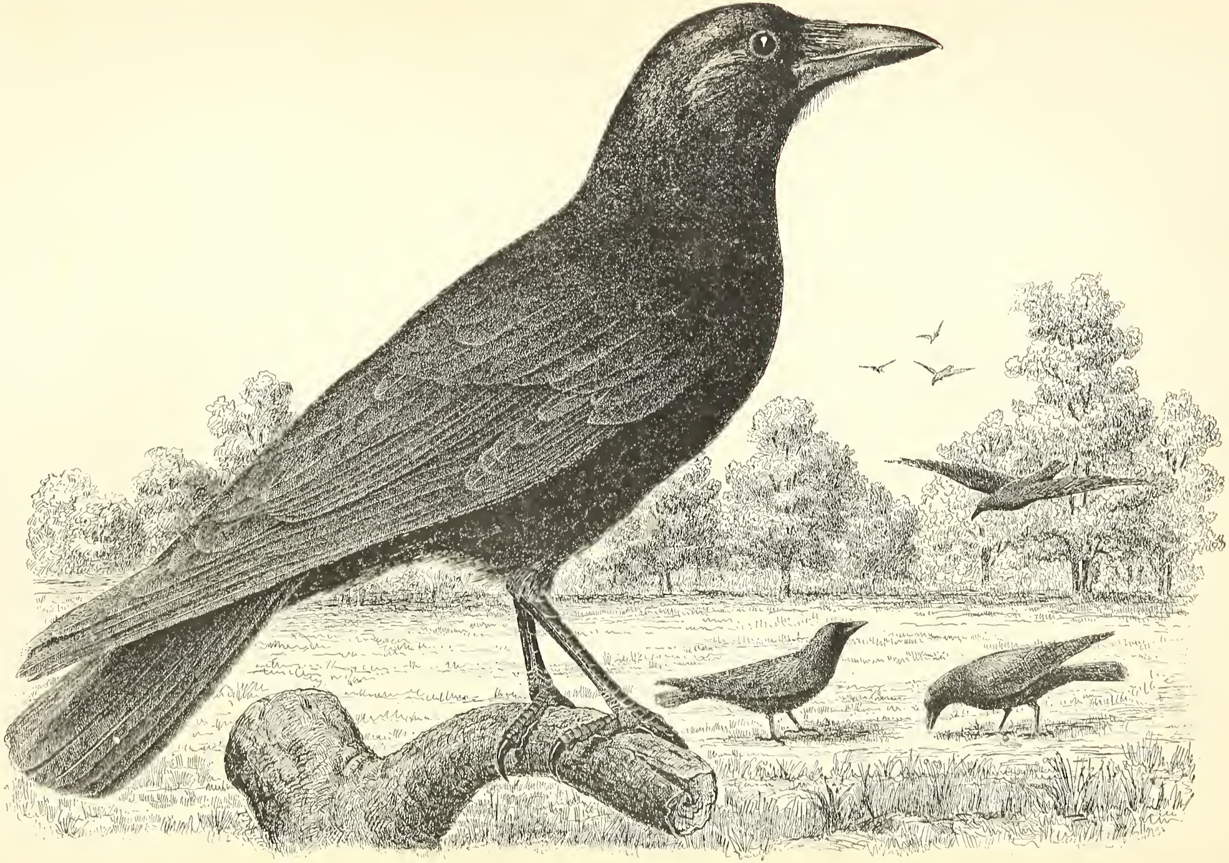

COMMON CROW, *Corvus americanus.*

BULLETIN No. 6

U. S. DEPARTMENT OF AGRICULTURE
DIVISION OF ORNITHOLOGY AND MAMMALOGY

THE COMMON CROW
OF THE
UNITED STATES

By WALTER B. BARROWS and E. A. SCHWARZ

GENERAL REPORT: WALTER B. BARROWS
REPORT ON INSECT FOOD: E. A. SCHWARZ

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LETTER OF TRANSMITTAL

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ORNITHOLOGY AND MAMMALOGY,
Washington, D. C., July 27, 1895.

SIR: I have the honor to transmit herewith, as Bulletin No. 6 of this division, a report on the economic status of the Crow, by Walter B. Barrows, a former assistant in the division of ornithology, and E. A. Schwarz, an assistant in the division of entomology. Mr. Schwarz has prepared the part on the insect food; Professor Barrows all the rest.

The original manuscript was very much more voluminous than the present report. Hundreds of notes from observers and 86 pages of tabular matter, showing the principal contents of each of the stomachs examined, have been omitted. The detailed lists of insects found in the stomachs by Mr. Schwarz have also been left out.

The present report is based on the examination of the contents of nearly a thousand stomachs. The quantity and quality of the evidence seem sufficient to justify a final conclusion respecting the economic status of the Crow, although a larger number of stomachs from some parts of the country would have been acceptable.

The most important charges brought against the Crow are: (1) That it pulls sprouting corn; (2) that it injures corn in the milk; (3) that it destroys cultivated fruit; and (4) that it feeds on the eggs and young of poultry and wild birds.

All of these charges are sustained by the stomach examinations, so far as the simple fact that Crows feed upon the substances named. But the extent of the injury is a very different matter.

In order to ascertain whether the sum of the harm done outweighs the sum of the good, or the contrary, the different kinds of food found in the stomachs have been reduced to quantitative percentages and contrasted. The total quantity of corn eaten during the entire year amounts to 25 percent of the food of adult Crows, and only 9.3 per cent of the food of young Crows. Leaving the young out of consideration, it may be said that in agricultural districts about one-fourth of the food of Crows consists of corn. But less than 14 percent of this corn, and only 3 percent of the total food of the Crow, consists of sprouting corn and corn in the milk; the remaining 86 percent of the corn, or 97 percent of the total food, is chiefly waste grain picked up here and there, mainly in winter, and of no economic value.

In the case of cultivated fruits the loss is trivial. The same is true of the eggs and young of poultry and wild birds, the total for the year amounting to only 1 percent of the food.

As an offset to his bad habits, the Crow is to be credited with the good done in destroying noxious insects and other injurious animals. Insects form 26 percent of the entire food, and the great majority of these are grasshoppers, May beetles, cutworms, and other injurious kinds. It is shown by Mr. Schwarz that during the May-beetle season, in May and June, these beetles form the principal insect food of the Crow. Only a few stomachs do not contain them, and stomachs are often filled with them. The fact that the May-beetle season coincides with the breeding season of the Crow is of special importance, the principal insect food of nestling Crows consisting of these beetles. Mr. Schwarz also finds that grasshoppers occur in the stomachs throughout the year; that during the May-beetle season they occur in the vast majority of stomachs, but usually in moderate numbers; that with the disappearance of May beetles toward the end of June they increase in number until in August and throughout the fall they constitute by far the greater part of the insect food, often occurring in astonishing numbers, and often forming the only insect food.

To the same side of the scale must be added the destruction of mice, rabbits, and other injurious rodents by the Crow.

In summing up the benefits and losses resulting from the food habits of this bird, it is clear that the good exceeds the bad and that the Crow is a friend rather than an enemy of the farmer.

Respectfully,

C. HART MERRIAM,
Chief of Division.

HON. CHAS. W. DABNEY, JR.,
Assistant Secretary of Agriculture.

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PREFATORY NOTE.

The present investigation of the food of the Common Crow was begun in 1885, and a general request for stomachs was made in the following year. A preliminary statement of the results of an examination of 98 stomachs—86 of the Common Crow (*Corvus americanus*) and 12 of the Fish Crow (*Corvus ossifragus*)—was published in the Annual Report for 1888, pages 498–535. The present report is based on an examination of the contents of 909 stomachs—nearly ten times as many as were available for the preliminary examination. The publication of the bulletin has been unavoidably delayed, mainly on account of the difficulty in obtaining Crow stomachs during the spring and summer months, but also because of the time necessary for a proper determination and study of the insect material. It is hoped, however, that the completeness of the investigation will atone for the delay.

Many of the notes and stomachs that have formed the basis of this report were collected by voluntary assistants in various parts of the country. To all these contributors we desire to extend our thanks. Nearly all the material, except the insects, found in the stomachs was examined by Prof. F. E. L. Beal, assistant ornithologist, under the supervision of the author. Dr. A. K. Fisher also rendered important assistance in identifying doubtful material, especially during the early part of the investigation. Further acknowledgments are due to Prof. C. V. Riley, formerly chief of the division of entomology, under whose direction the insect material was examined and reported on by Mr. E. A. Schwarz; to the late Dr. George Vasey, Botanist of the Department, and to his successor, Mr. F. V. Coville, and to other members of the botanical division, for assistance in naming seeds; and also to Mr. F. A. Lucas, of the United States National Museum, for the identification of many small bones and fragments, mainly of reptiles and batrachians.

W. B. B.

THE COMMON CROW OF THE UNITED STATES.

By Walter B. Barrows.

CHAPTER I.

GENERAL HABITS OF THE CROW.

GEOGRAPHIC DISTRIBUTION.

The Common Crow is generally distributed from the southern border of the United States north to about latitude 63°. It is abundant in the well-watered regions of the East, but in the West it is rare or local in the arid country, which comprises most parts of the Great Plains, the Great Basin, and the deserts of the Southwest from Texas to California. In southern Florida the Common Crow differs slightly from the northern bird, and is known as the Florida Crow. Four other crows and ravens are found in the United States. Along the Atlantic Coast from Long Island southward the small Fish Crow (*Corvus ossifragus*) occurs with the Common Crow, while on the Pacific Coast from Washington northward the Northwest Crow (*Corvus caurinus*) is found. The Raven (*Corvus corax sinuatus*) inhabits various parts of the United States. The White-necked Raven (*Corvus cryptoleucus*) is common locally in Arizona, New Mexico, and some other parts of the Southwest.

MIGRATION.

The fact that Crows are regularly migratory has been generally overlooked, chiefly because in most localities in the United States where Crows breed they are represented in winter by at least a few individuals. Even in Manitoba some may always be found in midwinter, and the same is true in parts of Minnesota and Wisconsin, and the entire northern tier of States. The great bulk of the species regularly moves southward in the fall and northward in the spring, the migration being as prompt and methodical as that of any other bird. It is probable, however, that few, if any, individuals migrate more than 500, or at most 1,000, miles. Crows as a rule get their food from the ground, and in journeying southward their principal object seems to be to reach a place where the snow does not cover the surface for long periods at a time, and where a fair amount of animal food is assured. While such conditions usually exist almost anywhere south of latitude 40°, the seashore and the banks of large rivers afford the best chances of obtaining a constant supply. Hence it seems probable that the great majority of Crows reared in the Northern States do not pass south of latitude 35°, but are concentrated at certain places, determined by the food supply, in the belt between the thirty-fifth and fortieth parallels. The great center of Crow population in the eastern part of this winter zone is in the neighborhood of Chesapeake Bay and its tributaries; a more western center is found near the junction of the Ohio and Mississippi rivers, while large numbers winter farther west, along the Arkansas and lower Missouri.

As usual with migratory birds, the northward or spring movement is more plainly marked, or at least more conspicuous, than the southward or autumn movement. In southern New York and Connecticut the spring migration often begins early in February, and by the latter part of that month or the 1st of March Crows in straggling flocks or singly appear in abundance all over New England and the Middle States. Occasionally the first arrivals come in flocks of many thousands, scattering to some extent to feed during the day, but collecting together to roost. More often the first migrants come in parties of a dozen or two individuals flying so far apart as to give the impression that each Crow is moving independently. In leaving winter quarters to move north in spring they depart in large flocks, and the same is probably true of the initial southward movements in the fall. These large flocks rarely if ever complete the journey with unbroken ranks, but divide and subdivide until in many cases the members arrive at their destination in small parties or even singly. Toward the close of each day's flight, however, single migrants show a decided tendency to unite with other stragglers, and these combined companies often reach some local Crow roost, where they pass the night with the Crows of the vicinity, or perhaps at a late hour rejoin the flock with which they started at daylight. Crows often fly until long after dark when they have a definite roosting place in view, but their migrations are performed mainly by day.

In the Middle and Southern States March and October are unquestionably the greater migration months for Crows, and under average circumstances the greater part of the movement takes place during the first half of March and the last half of October. This is shown by careful study of the dates of appearance at successive points in spring and fall and the increase or decrease at particular roosts.

CROW ROOSTS.

Crows are notoriously clannish birds, and except during a few weeks at nesting time are usually seen in flocks. Moreover, even while nesting they are more or less gregarious, for although two nests are seldom built on the same tree, yet half a dozen pairs often build within easy hearing distance of each other, and if one be disturbed all are likely to unite for common protection or protest. When the young are able to fly, the parents accompany them, forming little family parties of six or eight, and these soon associate with similar parties to form small flocks of twenty to fifty.

During migration, as already seen, Crows commonly travel in flocks of varying size, and in autumn they often congregate in large numbers, but only during winter do they unite to roost in immense communities. Many roosts are known where not less than 100,000 Crows spend the night during winter, and at some single roosts the number has been estimated to exceed 200,000. Most of these roosting places have been used year after year in the same way—the same individual trees for scores of years, and the same general locality probably for centuries.

Some of the roosts are in thick groves of pines or other evergreens, not necessarily large trees, but such as afford protection during storms; others are in deciduous trees (oaks, maples, poplars), while thick growths of willow and alders are chosen occasionally, and on the Delaware River Crows have roosted among reeds or coarse grass and brushwood overgrowing low islands. At a large roost on Arsenal Island in the Mississippi, near St. Louis, Mo., Mr. Otto Widmann found that "in ordinary weather the Crows roost on the trees of the island. * * * When the weather becomes severe, some of the Crows begin to pass the night on the sand bar, which at low water forms the western edge of the island, and when the cold becomes extreme all the Crows spend the night on the snow-covered bar or on the ice fields bordering it."

Whatever may be the nature of the place chosen, the Crows often begin to gather in the neighborhood several hours before nightfall, but do not actually settle upon the roost until it is almost dark. They begin to leave the roost soon after daybreak, scattering over the surrounding country to a distance of several miles.

In the latitude of Washington, D. C., and St. Louis, Mo., Crows begin to collect in some numbers at the roosts during the latter part of September, but it is probable that part of these Crows are transients which soon pass on to spend the winter farther south. About the last of October the roosts assume larger proportions, and Crows become very abundant in the surrounding country. By the end of November or early in December, in ordinary seasons, the winter roosts have attained their normal size, and it may be presumed the Crows occupying them are winter residents. All through the winter the numbers vary from several causes, the most important of which apparently is the prevalence of mild weather, during which many of the Crows form smaller roosts here and there, at a distance. During heavy gales, too, particularly if accompanied by rain or snow, belated detachments of tired Crows are very apt to settle in any convenient place when darkness overtakes them. Such temporary roosts are used at intervals all through the winter, but probably do not comprise 5 percent of the whole number of Crows in the neighborhood.

As already stated, most of the Crows inhabiting the northern half of the United States in summer are believed to pass the winter in a belt of country lying between latitude 35° and 40°. Within these boundaries or very close to them are located all the large winter roosts known to us.

The following is an imperfect list of all the large roosts known to be in use during 1886 and 1887:

List of the principal winter Crow roosts

Locality.	Extent.	Number of Crows.
New Jersey:		
Hainesport, Burlington County	20 to 30 acres	200,000-300,000.
Medford, Burlington County		Large numbers.
Tabernacle, Burlington County		Do.
Merchantville, Camden County	About 20 acres	200,000.
Reedy Island, Delaware River	About 50 acres	200,000.
Pennsylvania:		
Coatesville, Chester County	Several acres	
Davis Grove, Montgomery County	About 20 acres	200,000.
Lancaster, Montgomery County		Large numbers.
Maryland:		
Baltimore		Do.
Sandy Spring. Montgomery County	Small roost	10,000 (?).
District of Columbia:		
Washington (Arlington National Cemetery)	15 to 20 acres	150,000-200,000.
Indiana:		
Irvington		Large numbers.
Kentucky:		
Jessamine County		Do.
Illinois:		
Newman, Douglass County	Very large roost	
Missouri:		
St. Louis		70,000-90,000.
Pierce City	Large roost	
Nebraska:		
Peru, Nemaha County	do	100,000-200,000.
Kansas:		
Allen County	do	
Douglass County	do	
California:		
Posts. Monterey County	do	

In addition to these large roosts smaller ones have been reported from Syracuse, N. Y.; Amagansett, Long Island, N. Y.; Fishers Island, Long Island Sound; Middletown, Conn., and Wauwatosa, Wis.[1]

The immense winter colonies of Crows in the neighborhood of Chesapeake Bay early attracted the attention of naturalists, and both Wilson[2] and Audubon give graphic accounts of some of the large roosts known to them. But before their time the roosts had been carefully studied by Dr. Godman,[1] from whom the following quotation is taken:

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[1] Other roosts on the Connecticut River near Wethersfield, Conn., and on the Missouri River a few miles southwest of Kansas City, Mo., are mentioned by F. L. Burns, in Bull. No. 5, Wilson Ornith. Chapter, Oberlin, Ohio, March 15, 1895, pp. 7, 9.

[2] Wilson mentions roosts on the Hudson River 7 miles from New York City, and on the 'Pea Patch,' a small island in the Delaware River near New Castle, Del.—American Ornithology, Edinburgh ed., 1831, I, pp. 240-242.

"About the years 1800 to 1804, inclusive, the Crows were so vastly accumulated and destructive in the State of Maryland, that the government, to hasten their diminution, received their heads in payment of taxes, at the price of 3 cents each. The storekeepers bought them of the boys and shooters, who had no taxes to pay, at a rather lower rate, or exchanged powder and shot for them. This measure caused a great havoc to be kept up among them, and in a few years so much diminished the grievance that the price was withdrawn. Two modes of shooting them in considerable numbers were followed and with great success; the one, that of killing them while on the wing toward the roost, and the other attacking them in the night when they had been for some hours asleep. I have already mentioned the regularity with which vast flocks move from various quarters of the country to their roosting places every afternoon, and the uniformity of the route they pursue. In cold weather, when all small bodies of water are frozen, and they are obliged to protract their flight toward the bays or sea, their return is a work of considerable labour, especially should a strong wind blow against them; at this season also, being rather poorly fed, they are of necessity less vigorous. Should the wind be adverse, they fly as near the earth as possible, and of this the shooters at the time I allude to took advantage. A large number would collect on such an afternoon, and station themselves close along the footway of a high bank, over which the Crows were in the habit of flying; and as they were in a great degree screened from sight as the flock flew over, keeping as low as possible because of the wind, their shots were generally very effectual. The stronger the wind the greater was their success. * * *

"But the grand harvest of Crow heads was derived from the invasion of their dormitories, which are well worthy a particular description, and should be visited by everyone who wishes to form a proper idea of the number of these birds that may be accumulated in a single district. The roost is most commonly the densest pine thicket that can be found, generally at no great distance from some river, bay, or other sheet of water, which is the last to freeze or rarely is altogether frozen. To such a roost the Crows, which are, during the daytime, scattered over perhaps more than 100 miles of circumference, wing their way every afternoon, and arrive shortly after sunset.

"Endless columns pour in from various quarters, and as they arrive pitch upon their accustomed perches, crowding closely together for the benefit of the warmth and the shelter afforded by the thick foliage of the pine. The trees are literally bent by their weight, and the ground is covered for many feet [?] in depth by their dung, which by its gradual fermentation must also tend to increase the warmth of the roost.

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[1] Rambles of a Naturalist, Philadelphia, 1833, pp. 65–66, 103–125.

Such roosts are known to be thus occupied for years, beyond the memory of individuals; and I know of one or two, which the oldest residents in the quarter state to have been known to their grandfathers, and probably had been resorted to by the Crows during several ages previous. There is one of great age and magnificent extent in the vicinity of Rock Creek, an arm of the Patapsco. They are sufficiently numerous on the rivers opening into the Chesapeake, and are everywhere similar in their general aspect. Wilson has signalized such a roost at no great distance from Bristol, Pa., and I know by observation, that not less than a million of crows sleep there nightly during the winter season.

"To gather Crow heads from the roost, a very large party was made up, proportioned to the extent of surface occupied by the dormitory. Armed with double-barreled and duck guns, which threw a large charge of shot, the company was divided into small parties, and these took stations, selected during the daytime, so as to surround the roost as nearly as possible. A dark night was always preferred, as the Crows could not when alarmed fly far, and attack was delayed until full midnight. All being at their posts, the firing was commenced by those who were most advantageously posted, and followed up successively by the others, as the affrighted Crows sought refuge in their vicinity. On every side the carnage then raged fiercely, and there can scarcely be conceived a more forcible idea of the horrors of a battle, than such a scene afforded. The Crows screaming with fright and the pain of the wounds, the loud deep roar produced by the raising of their whole number in the air, the incessant flashing and thundering of the guns, and the shouts of their eager destroyers, all produced an effect which can never be forgotten by anyone who has witnessed it, nor can it well be adequately comprehended by those who have not. Blinded by the blaze of the powder, and bewildered by the thicker darkness that ensues, the Crows rise and settle again at a short distance, without being able to withdraw from the field of danger; and the sanguinary work is continued until the shooters are fatigued, or the approach of daylight gives the survivors a chance of escape. Then the work of collecting the heads from the dead and wounded began, and this was a task of considerable difficulty, as the wounded used their utmost efforts to conceal and defend themselves. The bill and half the front of the skull were cut off together, and strung in sums for the taxgatherer, and the product of the night divided according to the nature of the party formed. Sometimes the great mass of shooters were hired for the night, and received no shares of scalps, having their ammunition provided by the employers; other parties were formed of friends and neighbours, who clubbed for the ammunition and shared equally in the result.

"During hard winters the Crows suffer severely and perish in considerable numbers from hunger, though they endure a wonderful degree of abstinence without much injury. When starved severely, the poor wretches will swallow bits of leather, rope, rags, in short anything that appears to promise the slightest relief. Multitudes belonging to the Bristol roost perished during the winter of 1828–29 from this cause. All the water courses were solidly frozen, and it was distressing to observe these starvelings every morning winging their weary way toward the shores of the sea in hopes of food, and again to see them toiling homeward in the afternoon, apparently scarce able to fly."

In 1886 Mr. Samuel N. Rhoads contributed to the American Naturalist a valuable paper entitled 'Crow Roosts and Roosting Crows.' In most respects this paper gives a good idea of the character of these great roosts and their occupants. We must dissent, however, from Mr. Rhoads' opinion that "in winter a radial sweep of 100 miles, described from the city of Philadelphia and touching the cities of New York, Harrisburg, and Baltimore, will include in the daytime in its western semicircle fully two-thirds of the Crows (*C. americanus*) inhabiting North America, and at night an equal proportion in its eastern half." That the region described would contain more Crows than any similar area in North America is doubtless true, but it is now well known that this area by no means includes all the Crows reared in the Atlantic States, and probably none of those reared west of the Alleghanies.

Mr. Rhoads' account of the gathering of Crows at their roosts toward night and the manner of dispersal in the morning is quoted in full. He says: "A visit to one of the numerous roosts of New Jersey would repay anyone interested in nature and reward the curiosity of the most casual observer.

"The course adopted in assembling to and departing from the chosen spot is uniform everywhere. About an hour before sunset stragglers begin to appear, reconnoitering, as it were, to see that the coast is clear, and returning whence they came, as if to inform the main body of the result. In the course of half an hour the flocks begin to arrive in broken lines and detachments from all quarters, and, if the evening be calm, their earthward descent from a height of many hundred feet exhibits aerial prowess surpassing in daring elegance those of any other land bird with which I am acquainted. It is their invariable custom to descend to some spot in the neighborhood, from one-half to a quarter of a mile from the roost, preliminary to assembling there for the night's repose. This may be either upon the adjoining fields or on woodland tracts near by. Such preliminary gatherings, as Godman observes, seem to have a definite object—either for toilet or gastronomic purposes—a time, also, if we may judge by their clamor, of general conversation, some rejoicing, some repining, in their varied experience of the last twelve hours.

"The aerial evolutions of this descending multitude, coupled with the surging clamor of those which have already settled as successive re-enforcements appear, and which at a distance greatly resemble the far-away roar of the sea, may justly awaken emotions of sublimity in the spectator. To descend almost perpendicularly from a height of

1,000 feet above earth to the very tree tops and then to glide above them on half-closed wings with a resultant momentum that is almost startling in its arrowy velocity, is a favorite manœuver and when two such playfellows pursue each other in this headlong swoop their turnings and twistings and doubling contortions amaze the beholder. * * * Until sunset this novel scene continues without interruption, whilst field and forest in the vicinity of their great dormitories are shrouded by the thousands which have alighted; and were it not for the deafening clamor, the living pall which overspreads the scene might well suggest a land of mourning and death. When they settle on the ground on such occasions they resemble gulls on a sand bar, each standing motionless with its head toward the breeze. The whole thing seems unnecessary, as they mostly do nothing but cry out to their companions in the air and tumultuously applaud their hairbreadth escapes and feats of daring, yet sitting quietly until the setting sun warns them to make ready for the last act—going to bed.

"If we understood Crow language, perhaps we could now recognize a distinct signal from some grand master of their assembly, summoning all to repose.

"Be this as it may, a similar impulse now seizes the throng and the air fairly darkens as successive companies take wing and in silence betake themselves to the roost, flying low as if to avoid observation. Many Crows in approaching the place of preliminary gathering necessarily fly over the roost, but not a bird enters it until the general movement begins after sunset. The self-imposed discipline and obedience of such an army puts to shame the strictest military code. Think now of a miserable, weary Crow, which, having winged his way thither a distance of 20 miles, arrives about sunset at the roost; but the ingathering not having yet begun, witness how like a true soldier he flaps on to join his more punctual brethren who have settled half a mile farther off to gossip and plume themselves before retiring.

"On one occasion I observed large companies arriving in the roost near Merchantville, at a time of full moon, for nearly an hour after sunset. Between the intervals of arrival all would become quiet in their bedchambers, but, as a more belated company drew near, their cries were responded to by the roosting Crows in a different tone. The fliers would hurriedly ejaculate 'yur, yur, yur,' * * * giving each utterance a rising inflection, as if inquiring anxiously of their whereabouts, while those in the roost answered in a falling, drawling tone by slowly repeating their usual 'caw' and lengthening it to 'ca-aw,' 'ca-aw,' 'ca-aw,' as if to assure their friends they were resting comfortably. * * *

"The programme of dispersion from the roost in the morning to their feeding grounds is as follows:

"After an hour's babel (for such verily is the seeming confusion of tongues) a few Crows essay to take leave, but as soon as this folly is observed it literally 'brings down the house,' and when one imagines the simultaneous shout of 20 acres of Crows, one may not wonder that 'the house' is fully able to bring down the Crows. The few Crows resume their perches and comparative quiet is restored.

"Numerous attempts are thus made with a like result until nearly sunrise, when detachments of 500 to 1,000 successively take wing amid the wildest enthusiasm. These circle and wheel about in headlong swoops and elegant curves above the forest, and, each having taken his bearings, moves off in one of the many lines of flight that, eastward, westward, to north and south, extend from the common center as the spokes of a wheel.

"Ere the sun looks out upon the scene a silence almost oppressive broods over field and woodland, and to one who so recently beheld this departure, a scattered remnant of the mighty host only serves to heighten the feeling of contrasted desolation."

In 1888 Mr. C. L. Edwards,[1] then of the Johns Hopkins University, published the results of careful observations made on a large roost near the city of Baltimore. Perhaps the most valuable part of this paper is the attempt to estimate the number of Crows using this roost. Much difference of opinion has existed among observers as to the numbers resorting to any particular roost, the estimates for the same colony ranging all the way from 5,000 to several millions. It has been generally assumed that the numbers were much overestimated, since most attempts to number the birds have been scarcely more than guesses. Mr. Edwards' results may be accepted with some degree of confidence. He says:

"Seven miles southwest from Baltimore, a half mile southeast of Arbutus station on the Baltimore and Potomac Railway, is a tract of land of about a half mile square on which are several patches of woods which furnish the roosting ground for a winter colony of Crows. It seems from the testimony of the owners of this land that the crows have roosted there for about twelve years, having previously occupied a piece of woods a half mile or more to the westward, which they abandoned when housebuilding and woodcutting by the inhabitants made it undesirable. * * *

"A determination of the exact number of Crows here collected is not possible, but even the most sober observers place it among the hundreds of thousands. As a basis for an approximate calculation, I have made the following observations at the roost. With the aid of two friends, 15 different square rods, taken here and there at random, were paced off, and the number of trees thereon capable of furnishing roosting tops counted. An average gave us $9\frac{3}{5}$ trees per square rod. At any one roosting the Crows occupy about 10 acres (160 by $9\frac{3}{5}$ by 10), or 15,360 trees. If on each tree 15 Crows roosted—and that, if anything, is not too large an average—we should have 230,400 Crows in the colony.[1] Because of the dim light at sunset, my attempts at taking instantaneous photographs of the incoming streams of Crows were failures. A view, however, of one of the gathering flocks, taken about an hour before sunset, as it flew by in a straggling stream, shows 273 Crows in the photographic field. On this basis, the flying time (an average of a number of observations) for the bird to cross the field being fifteen seconds, in three streams coming in for one hour we should have 199,560 Crows. But the streams toward the middle and end of the incoming are manifestly much larger than the above, so this number may be taken as a minimum estimate."

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[1] Am. Journ. Psychology, I, May, 1888, No. 3, pp. 443, 453-454.

At various times I have made careful estimates of the number of Crows resorting to the roost in and near Arlington Cemetery, just across the Potomac from Washington. On one occasion it was possible actually to count all the Crows which had settled on one stretch of the sandy flats near the roost, and the number slightly exceeded 8,000. A much larger number were perched in trees and scattered over the surrounding fields, and large flocks were constantly arriving. Presently all or nearly all those on the flats took wing and joined the main body, yet the addition of these 8,000 Crows did not appear to increase the total number perceptibly. Subsequent examination of the woods showed that the colony occupied 12 to 15 acres. Counting 10,000 to the acre the total would be from 120,000 to 150,000 Crows. The most conservative estimate of the number roosting at any one point in that vicinity placed the number at 35,000.[2] Crows probably roost here and there in favored spots over a tract of country 7 or 8 miles long and perhaps a mile in breadth, but frequently the members of several of these roosts may unite for one or more nights, and in very stormy weather concentrate at some one point. Thus in visiting the Arlington roost at intervals of several days I was struck with the great difference in the numbers at the roost on different nights.

The following notes on Crow roosts illustrate the fact that these winter colonies are always essentially alike. Mr. W. P. Hay, writing the division under date of February 24, 1890, describes a roost near Irvington, Ind., as follows:

"For several years the Common Crow has been very abundant about here, especially in winter. Every morning at about half past 5 a great string of crows, extending as far as the eye can reach, can be seen flying toward the south. At about 4 o'clock in the evening they return. On the 15th of February I visited the roost, which is situated about 2 miles north of here. It is in a thick beech wood of perhaps 50 acres. I reached the place at about half past 4, and in a few moments the Crows began to arrive. They came in five 'streams'—from the north, northeast, northwest, south, and southeast. Soon the trees were black with them, and the noise they made was almost deafening. After being shot at several times they all congregated in one corner of the wood, and when shot at again left the trees and settled on the ground in the neighboring fields. They were now so badly scared that it was impossible to get within gunshot, so throwing myself on the ground to be as near as possible out of sight, I began to imitate as well as I could, the cawing of a Crow. Almost immediately they answered, and every Crow in the field came circling over me. At first they were perhaps 200 feet in the air. They all would caw as loudly as possible for perhaps a half minute, then they would be still. If answered, they would come lower and caw again. It was so near dark I suppose they could not see me, and at last they were within 20 or 30 feet of the ground. I shot and they flew away, but returned as soon as I began to imitate them again. At last they all departed for another woods."

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[1] It is difficult to realize the meaning of such a large number, and perhaps an illustration may help. It happens that if one Crow came in each second, day and night, it would require just sixty-four hours for this number to assemble.

[2] The number of Crows roosting in Arlington Cemetery during the winter of 1894–95 was very much reduced.

The following description of roosts in eastern Nebraska has been condensed from an article on this subject by W. Edgar Taylor,[1] of the State Normal School, Peru, Nebr.:

Some twenty-five or thirty years ago, in the early settlement of Nebraska, the Crow (*Corvus americanus*) was a rare bird, even on the Missouri, where now it is so very abundant as to attract the attention of the most careless observer. It is stated by many old residents that it appeared in eastern Nebraska about twenty-five years ago, and at the same time the Raven (*C. corax sinuatus*) and the Magpie (*Pica pica hudsonica*) began to disappear, and that the Crows have been increasing continually since. It has been their habit about the last of September to select some suitable point for roosting, usually some grove of willows on an island in the Missouri. This roost is retained till about the first of May, when they again disperse till the coming September or October.

I have observed their habits at a roost near Peru, Nebr. The principal part of this roost is on McKissicks Island, on the Missouri side of the Missouri River, about 2 miles above Peru. Another roost exists on Hogthief Island, some 5 miles above Peru, as well as a smaller roost on the Nebraska side of the Missouri River, about a mile above Peru. Another roost is said to exist 10 miles north of Hogthief Island, and we have reason to believe that others will be found along the river within the State.

All the roosts in Nebraska, so far as definitely known, are in willows large enough to sustain the weight of the Crows. We have heard of several roosts thought to be in oaks and other trees.

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[1] Annual Rept. Nebraska State Board Agriculture for 1887, pp. 119–120.

We believe that not less than 50,000 Crows frequent the roosts above mentioned, the extent of which is estimated as follows: Roost 1 mile north of Peru, 2 to 3 acres; Hogthief Island, 4 to 5 acres; McKissicks Island, 15 to 40 acres.

Of the various Crow roosts on record, the lowest estimate of Crows per acre is 5,000, and with this as a basis the lowest estimate on the three roosts near Peru would be over 100,000.

Why the Crows flock to these places to roost we can not explain. From a somewhat careful investigation we are confident that many of the birds make a journey of 40 to 50 miles and return each day. From daylight to sunrise on a bright morning they may be seen flying in long flocks in various directions from the roost, only to begin their return about 3 p. m., and they keep coming in until dark, and sometimes later. Before retiring for the night they collect on sand bars along the banks of the river, where they remain until about dark, when they rise in flocks and fly to the roost. Many play along the river and are overtaken by darkness while 5 or 6 miles away, but they invariably come to one point on the river before taking their night's rest. The noise made in taking flight for the day's journey has been heard 3, 4, or even 5 miles, depending on the condition of the atmosphere.

About the 1st of May these roosts are completely deserted. Where do the Crows go? Many breed in the neighborhood, and their nests have been found by students of the State Normal School; but from what we have been able to gather there are not Crows enough breeding in eastern Nebraska, western Iowa, and northwestern Missouri to account for all the Crows roosting on the Missouri during winter.

Mr. George A. Coleman, of London, Nebr., wrote in July, 1888, concerning these same Crow roosts: "During the winter they have their roosting places along the Missouri River and on the islands. The favorite roost is on Hogthief Island, which is about 6 miles above Peru, Nebr. Here from October until March they come to roost every evening, and from about 4 o'clock p. m. until 6 a constant stream of them can be seen coming from every direction, and the noise they make is deafening. At daybreak they scatter to the adjacent feed lots and fields, only to return in the evening. The number that roost on this and adjacent islands is estimated to be 100,000, and they are steadily increasing."

A roost is thus described by Mr. S. S. Rathvon[1] in Lancaster County, Pa.: "We have now a formidable Crow roost on the Conestoga, in this county, about 6 miles south of Lancaster City, but with their usual cunning I have not yet learned that they 'tease sheep near home.' The gentleman upon whose farm the 'roost' is located says they rise up every morning, and after forming four divisions, the one flies east, another west, another north, and another south, returning again in the evening. About the same number fly in these same directions and about the same hours every day."

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[1] American Naturalist, III, 1869, pp. 102–103.

Mr. J. Ellis McLellan, a field agent of the division, discovered a large Crow roost on one of the tributaries of the Big Sur River opposite the little settlement known as Posts, in the redwoods of the Santa Lucia range, south of Monterey, Calif., in March, 1894. Mr. McLellan states that the Crows in coming to this roost never come from the south, which is a mountainous wilderness, but from the north, where there are settlements and food.

WHY DO CROWS ROOST IN COMMUNITIES?

Much speculation has been expended in attempts to explain the object of these gatherings of Crows. The theory that they thus escape the attacks of some of their natural enemies fails from the fact that Crows have very few natural enemies—practically none except a few hawks and owls, and these probably are attracted rather than deterred by the presence of numbers.

Whether the large owls actually visit the roosts at night and feast on the sleeping Crows we have no means of knowing, but it is certain that during the day, when all the able-bodied Crows are absent from the roost, several of the larger kinds of hawks prowl about the vicinity and pick up the weak or disabled individuals which remain.

If Crows seek immunity from man by roosting in flocks, they must be sadly disappointed, for such gatherings are often looked upon as nuisances which should be promptly abated, and sometimes, as stated by Godman, they have been the scene of unprecedented slaughter. Yet even when driven away night after night the crows continue to return with the utmost persistency, and though they may change the roosting place temporarily, they are pretty sure to come back to it sooner or later. If the places selected were always well sheltered, or the trees afforded specially good perches, some conclusions might be drawn from these facts, but such is not the case. Many of the roosts, it is true, are in thick pines, but by no means all. Sometimes oaks and maples are chosen, sometimes cottonwoods or willows, sometimes beds of reeds, or even the bare ground on the surface of snow or ice. Godman supposed that the birds crowded together for warmth, and even suggested that the decomposition of their accumulated droppings would add to the heat. It may be asserted confidently that there is nothing in either of these ideas. The most probable explanation is found in the social nature of the Crow, which is conspicuous at all seasons.

DEPOSITS AT CROW ROOSTS AS EVIDENCE OF THE CHARACTER OF WINTER FOOD.

The Crow is one of the most omnivorous birds, and its digestive system is well adapted to the utilization of almost anything containing nutriment. Unlike the gallinaceous birds it has no true crop, yet it undoubtedly carries food in its distensible gullet when feeding its young, and at all times it swallows immense quantities of gravel or sand to aid in grinding up hard food in its gizzard-like stomach. Ordinary fowls which utilize hard substances in this way retain particles of sand or gravel until they are worn to powder, or at least have lost all sharp edges and corners, when they pass off through the intestines, fresh supplies being taken from time to time. Crows, on the contrary, eat large quantities of sand and gravel whenever their food demands it, and so soon as the trituration of this food is complete the sand and pebbles are expelled by the mouth, together with any indigestible substances of which the bird wishes to rid itself. All birds of prey are known to eject similar masses of undigested material, such as bones, hair, teeth, scales, and bits of shell, while some other birds, as kingfishers and flycatchers, have similar habits. These birds, however, swallow no sand or other hard matter to assist in grinding the food, and hence the ejecta, commonly called 'pellets' or 'castings,' consist entirely of the less digestible parts of the food.

Crow stomachs that do not contain some sand or gravel are rare at any time of year, and during the colder months when hard food enters most largely into the diet, the quantity of grinding material used every day is enormous.

On visiting a Crow roost for the first time one can not fail to be impressed by the great quantity of refuse food and sand scattered about. At the large roost in Arlington National Cemetery, Va., just across the Potomac from Washington, the deposit which covered the ground late in the winter of 1886–87 appeared at first glance to consist entirely of four substances: (1) Hulls of Indian corn in greatest abundance; (2) seeds of various kinds, mainly poisonous and harmless species of *Rhus*, with a considerable number of seeds of flowering dogwood, sour gum, and a few other species; (3) sand and gravel in large amounts; (4) the chalky excrement which matted together and more or less obscured the other components of the deposit. After heavy rains or melting snow the soluble excrement very largely washes away, the sand settles down to the lowest layer, and the surface appears to consist entirely of seeds, hulls of Indian corn, and some of the coarser gravel, particularly bits of coke, charcoal, brick, and shell. Of course other materials enter into the deposit, but those mentioned are the most conspicuous. At this roost I was seldom able to find any entire 'pellets' or 'castings'—doubtless because the Crows roosted well up in the tops of young and thickly branching trees, so that the pellets were broken to pieces by the fall or by striking on twigs and branches in the course of their descent.

The first perfect specimens of Crow 'pellets' seen were sent us by Mr. Otto Widmann, who collected them from the shores and ice of Hospital Island, in the Mississippi River, near St. Louis, Mo. Subsequently many such pellets were obtained from caged Crows kept during an entire winter; and still later other pellets were sent us from roosts in Pennsylvania, Indiana, and Kentucky. The usual size and appearance of these pellets is shown in the accompanying figure (fig. 1):

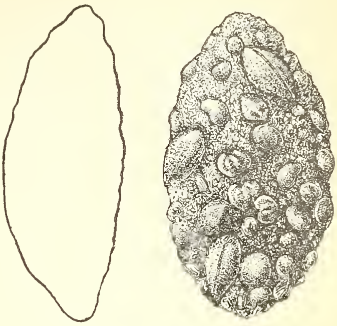

FIG. 1.—Crow pellet or casting.

The number of seeds distributed by Crows is enormous, and since it has been shown by experiment that the vitality of such seeds is not impaired by the partial digestion to which they are subjected, it is evident that Crows effect the distribution of many plants.

Reference to the chapter on the vegetable food of the Crow (pp. 81–87) will show that the stomach contains fruit seeds at all seasons, but especially during the autumn. It is certain, therefore, that southward-bound Crows deposit the seeds of many common fruits all along their migration route. Some of these, as the wild cherry (*Prunus*), flowering dogwood (*Cornus*), and red cedar (*Juniperus*), produce valuable and beautiful trees or shrubs, while others, like the poison ivy and poison sumac (*Rhus*), are detestable weeds. In the vicinity of roosts such seeds are sown by the million; many of these survive and add to the store of food for birds, and some to the misery of mankind.

The following facts serve to show how extensive is this seed planting by Crows in the vicinity of the winter roosts: On February 8, 1889, I visited the well-known—almost historical—Crow roost located on the Virginia side of the Potomac River just opposite Washington, D. C. The exact location of this roost varies from time to time, but at the date mentioned it was entirely within the grounds of the national cemetery at Arlington, and covered an area of 12 or 15 acres of second-growth deciduous trees. The ground beneath these trees was pretty evenly covered with the ejecta of the Crows, forming a deposit which in places was an inch or more thick, though the average deposit was probably rather less than half an inch. A representative spot free from underbrush was selected, and all the material above the leaves from an area 2 feet square was carefully collected, dried, and examined. The weight of this material when dry was almost exactly 1 pound, and it contained (aside from gravel, bits of bone, shell, corn hulls, and some excrement) the following seeds:

	Number.
Poison ivy (*Rhus toxicodendron*)	1,041
Poison sumac (*Rhus venenata*)	341
Other sumacs (*Rhus*)	3,271
Juniper or red cedar (*Juniperus virginiana*)	95
Flowering dogwood (*Cornus florida*)	10
Sour gum (*Nyssa aquatica*)	6
Total	4,764

A little calculation shows that the roost of 15 acres must have contained upward of 778,000,000 seeds, or more than enough to plant 1,150 acres as thickly as wheat is sown.

Of course the seeds thus dropped at the roost are subject to such unfavorable conditions that comparatively few grow, but it must be remembered that Crows spend only the hours of darkness at the roost, while during at least twelve hours each day they are dispersed far and wide over the surrounding country, collecting and distributing these seeds. The process of digestion—at least the preliminary process—is very rapid in Crows. A caged Crow experimented on during several months in the winter of 1889–90 ate berries of poison ivy with greater relish than any other wild fruit obtainable. He swallowed about 80 berries within a few moments, taking several mouthfuls of sand immediately afterwards, and about thirty minutes later he disgorged a large pellet consisting entirely of sand and the seeds of the *Rhus* berries, the latter with every shred of pulp removed by the action of the gizzard-like stomach. Subsequent experiments showed that indigestible substances, such as the teeth and bones of mice, hard seeds, snail shells, and so on, were not always disgorged with such promptness. In one case a white-footed mouse (*Peromyscus leucopus*) was fed to this Crow in the forenoon, and later in the day—but before any pellet had been disgorged—a common house mouse (*Mus musculus*) was given him. In little more than an hour afterwards a pellet was disgorged consisting mainly of the fur and bones of the common mouse—the last swallowed—and it was not

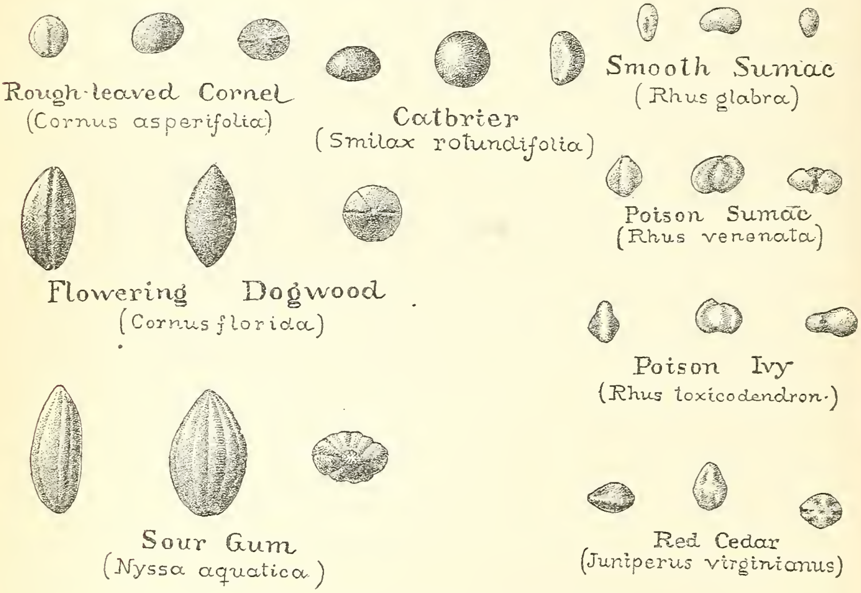

FIG. 2.—Some common seeds found in Crow pellets.

until nearly twenty-four hours later that the teeth of the white-footed mouse were ejected. Experiments made with various other articles of diet containing hard parts showed conclusively that although the indigesta were commonly disgorged in from one to four hours after eating, some pieces were often retained for twenty-four hours or even longer, and from the presence in Crow stomachs of bits of much worn bone, or of seeds worn smooth by constant attrition, it seems certain that such things are sometimes kept for even longer periods. It should be stated further that on several occasions well-grown mice were fed to the same Crow, and the pellets subsequently disgorged showed no trace of bones, but consisted solely of hair, teeth, and the inevitable sand. There is no reason to doubt that the bones were ground up in the stomach and completely digested.

The amount of sand or gravel taken by an average Crow during cold weather is almost beyond belief. When fresh sand was put into the cage of the Crow he would put his head down close to the sand, turn his bill sideways and half open, and swallow, time after time, all that his bill would hold. In this way he frequently took the equivalent of three or four teaspoonfuls of clear sand in less than a minute, washing it down immediately with copious drafts of water. After witnessing this a few times, and finding that it was repeated at intervals all through the day, usually soon after eating, the thick deposit of sand and gravel which always occurs at Crow roosts was easily accounted for.

CHAPTER II.

ANIMAL FOOD OF THE CROW.[1]

With a few minor exceptions the entire economic relations of the Crow depend upon its food habits. What the Crow eats or does not eat determines, directly or indirectly, the nature and extent of his services or damages to the agriculturist. The sources of information on this subject are various, and each is open to some objection which can not be entirely eliminated.

METHODS OF INVESTIGATION.

By carefully watching Crows, either with the naked eye or with a field glass, facts may be observed which are of more or less value. Thus, in cold weather, when Crows are seen to visit the carcass of a dead animal, the inference is fairly safe that they are eating the flesh. During hot weather, however, numerous flies, maggots, and scavenger beetles in and about the carcass might be the attraction instead of the carrion.

Frequently a Crow may be seen robbing the nest of some useful bird or despoiling a cherry tree or strawberry bed of its fruit, and in such cases the common inference is that these are examples of regular habits of the bird, and that much of his living is gained in this way. Such an inference, however, is not justified by the facts, and only a long series of similar observations would render it even probable. Again, a Crow may be seen walking quietly about in a meadow or pasture, frequently picking up something. Nothing of the nature of this food can be discerned—even with the best field glass, and the observer is left to speculate whether it be insect, seed, sprout, bulb, fruit, or perhaps a mixture of all. No one habit is so universally known as that of pulling up Indian corn. Almost every farmer has seen it done, and often the rows have been examined within a few moments after the crows have left, yet there are still some observers who contend that the corn is pulled for the sake of the grub or worm hidden near its root, and that the seed corn itself is seldom or never eaten. It is difficult to prove that the missing seed corn has been broken off and left in the ground when the sprout was pulled, and still more difficult to show that any grub or worm has been taken from the ground.

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[1] The insects eaten by the Crow are discussed in chapter III, pp. 56-71.

By careful experiment with living Crows—either caged or tame—many interesting points may be determined, though the natural appetite and food of a bird can not always be determined from the study of partially domesticated individuals. There remains but one method of study which promises anything like uniformly good results, namely, the examination of the actual contents of the stomachs of Crows.

For many years the division has been collecting Crow stomachs from every part of the country and at all seasons of the year. This collection numbers more than 900, most of which were taken in summer. As the examination of these stomachs has been supplemented by a large quantity of material from the winter roosts, it is believed that the data at hand are ample for the settlement of all the important questions relating to the food of Crows. In collecting these stomachs the utmost care has been taken to preserve all data that might throw light on the habits of the bird or in any way assist in the identification of the contents of the stomach. In most cases the following facts have been recorded: (1) Sex and age; (2) date of capture; (3) hour of capture; (4) town, or at least county, where killed; (5) character of actual place where killed; (6) name of collector; (7) remarks as to place of killing, occupation of bird when killed, character of crops in vicinity, and abundance of any particular food.

METHOD OF EXAMINING STOMACHS.

Since the determination of the various ingredients of the stomach contents is not always a simple matter, a description of the method pursued may be of interest. A few stomachs are obtained fresh, but the great majority received in the laboratory are preserved in alcohol. The process of examination, however, is essentially the same in both cases. A stomach is cut open and by means of a jet of water the contents are washed into a dish; then more water is added. Any conspicuous insects or large pieces of food that float are picked out and allowed to drain on blotting paper. The water covering the remainder is poured upon a filter and replaced by fresh water, which in turn is decanted upon the filter, and the process continued until the water remains clear and most of the lighter material has been removed. The coarser material is now spread out thinly under water and examined with a hand lens. By tilting the dish from side to side most of the sand or gravel can be separated and this is collected on a blotter by itself. The remaining coarse or heavy material is thoroughly examined with a magnifier. The seeds and grain are picked out and placed by themselves, also the bits of bone, shell, and the hard parts of insects. Sometimes this results in the separation of a dozen or more little heaps, each composed of one kind of material, and these heaps are arranged in three groups, composed respectively of animal, vegetable, and mineral matter. The mineral matter is examined for bits of shell, teeth of fish, reptiles, or mammals, and small, heavy bones, which often give a clew to the character of some of the soft food. The utmost care is needed to distinguish fragments of the hard parts of insects, particularly jaws, and the heads of weevils, and also small seeds that are likely to be overlooked among the bits of sand and gravel. The finely broken bits of insect shell usually float. Advantage is taken of this fact by throwing water into the vessel in a strong jet so that it may entangle bubbles of air and rise to the top, where they can be skimmed off.

The fine matter collected in the filter is examined under the hand lens, or the compound microscope if necessary, and by comparison with the coarser material it is possible frequently to determine not simply that it is vegetable or animal dust, but to name the particular animal or plant from which it came. In any case, the animal, vegetable, and mineral components of this fine material are separated and added to the coarser material already isolated.

After the materials contained in the stomach are recognized the next step is to determine the percentages of animal, vegetable, and mineral matter. For this purpose the smallest heap or mass of identified matter is selected as the unit, and each of the other heaps is divided into portions of like size. Then, by a very simple process, it is possible to determine the proportion of each ingredient of the food, and it has been found most convenient to express this proportion in percentages. For instance, if the heap of sand and gravel is selected as the unit, the animal matter may be 2½ times as much and the vegetable matter 3½ times, giving a total of 7 parts, each of which represents 14.3 per cent. In this case, therefore, the record would stand: Animal matter, 35.7 percent; vegetable, 50 percent; mineral, 14.3 percent. The proportions by weight would be very different from those by bulk, and these again would differ from those based on the numbers of individual seeds or insects found in the stomach.

In the case of a bird which eats insects only it might be possible to use the numerical method with some accuracy; yet even then much would have to be left to individual judgment in estimating how many small insects were equivalent to one large one, or how many harmful insects would be necessary to offset the consumption of a given number of beneficial insects. Moreover, only under the most favorable circumstances would it be possible to determine just how many individuals of each kind were represented in the stomach contents, for, even if swallowed whole, so soon as digestion begins the individual insects become dismembered, crushed, and broken, and within a short time only the hardest parts, such as the heads, wing covers, legs, and jaws, remain in recognizable condition.

It has seemed best, therefore, in attempting to determine the proportions of the various food substances in Crow stomachs, to depend upon the method of equal masses or bulks, which method is adopted in the present bulletin. In most cases the number of individual seeds, insects, or other animals has been recorded also, but these numbers have not been considered in determining percentages.

RELATIVE PERCENTAGES OF ANIMAL AND VEGETABLE FOOD.

The average quantities of animal, vegetable, and mineral matter contained in the entire number of stomachs could be easily computed; but such averages would be of little value in view of the wide differences in the numbers of stomachs examined in different months. Evidently the averages for the year must be obtained on a different basis, allowance being made for the discrepancies in the number of stomachs examined. The nearest approach to such a basis is found in the monthly averages given in the following table:

Table showing average percentages of the animal, vegetable, and mineral contents of 909 Crow stomachs, arranged by months.

Month.	Number examined.	Animal.	Vegetable.	Mineral.
January	53	21.5	60.9	17.6
February	23	10	71	19
March	26	19.2	67	13.8
April	42	62.1	31.2	6.7
May	364	66.6	29.5	3.9
June	165	49.5	46.3	4.2
July	45	37.3	55.6	7.1
August	24	37	56.9	6.1
September	44	27.1	66	6.9
October	46	18.8	67.4	13.8
November	18	33.2	55.5	11.3
December	59	12.1	74.3	13.6

By averaging these results it is possible to reach a conclusion which is correct so far as the monthly averages themselves are trustworthy. In cases where 40 or more stomachs have been averaged for any one month the result may be taken as approximately correct, and when, as in May and June, the number exceeds 100, it is probable that the examination of twice as many would not alter the averages materially. November is the month about which most doubt exists, although the numbers for February and March are also too small. The results in the case of the last-mentioned months, however, are strengthened by the examination of material from the crow roosts, while the results for August are partially confirmed by the fact that they are, as theoretically they should be, intermediate between those of July and September.

On this basis the annual averages of stomach contents are as follows: Animal matter, 32.9 percent; vegetable matter, 56.8 percent, and mineral matter, 10.3 percent. Roughly speaking, it may be said that one-third of the food annually consumed by Crows consists of animal matter, about three-fifths of vegetable matter, and about one-tenth of mineral matter. Of course the latter component is not food, strictly speaking, and its elimination would change the proportions of food proper to: Animal food, 36.6 percent; vegetable food, 63.4 percent

However, as a certain amount of sand or gravel is essential in grinding grain and other vegetable matter, it seems desirable to take it into consideration, at least while dealing with the general proportions of the elements of the food.

The accompanying table shows the number of stomachs examined for each month and the number containing each of the more prominent articles on which the Crow is known to feed:

Table showing contents of Crow stomachs, by months.

[The figures indicate the number of stomachs containing the article named.]

Month.	Number of stomachs examined.	Carrion.	Rabbits.	Mice.	Poultry or wild birds.	Egg shells.	Reptiles and batrachians.	Fish.	Crawfish.	Mollusks.	Insects and spiders.	Corn.
January	53	26	1	......	......	7	3	2	4	6	21	31
February	23	6	......	1	......	1	1	1	......	2	10	16
March	26	6	......	3	......	3	2	3	3	1	16	12
April	42	2	3	11	2	......	15	8	9	1	36	17
May	364	57	31	45	60	......	175	15	83	23	358	214
June	165	22	3	5	23	......	45	4	15	9	157	68
July	45	4	......	4	5	......	8	3	4	3	42	14
August	24	4	......	2	......	......	2	1	1	1	24	6
September	44	3	......	......	4	......	4	1	4	4	40	22
October	46	4	......	4	......	......	3	2	5	9	42	21
November	18	3	......	1	1	......	2	3	2	6	17	10
December	59	9	1	2	......	......	3	3	9	10	30	48

Month.	Wheat.	Oats.	Buckwheat.	Mast.	Seeds (grass, weeds, etc.).	Harmless *Rhus*.	Poison *Rhus*.	Other berries.	Apples.	Grapes (wild and cultivated).	Strawberries, blackberries, and raspberries.	Cultivated cherries.	Wild cherries.
January	3	5	......	8	13	20	10	3	1	......	......	......	......
February	1	2	......	5	3	8	1	2	......	......	......	......	......
March	1	4	2	8	8	2	......	......	1	......	......	......	......
April	2	4	2	2	6	3	......	3	1	......	......	......	......
May	6	6	3	24	11	1	......	2	......	......	2	3	......
June	3	13	6	6	6	3	1	12	......	......	16	37	......
July	10	3	......	3	4	......	......	6	1	......	12	13	......
August	4	3	......	......	1	......	2	6	2	3	2	......	5
September	4	3	1	7	2	......	8	13	1	12	1	......	6
October	5	1	1	20	4	......	16	9	......	15	......	......	2
November	1	1	......	7	1	2	7	3	1	2	......	......	......
December	3	2	......	9	9	13	14	4	......	2	......	......	......

The assumption that Crows will eat any available animal food may be allowed to stand as substantially correct, with some important reservations as regards insects, and it remains simply to discover what kinds of animal food are most available, and what preferences are shown when choice is possible. The following table shows the different kinds of animal food commonly found in Crows' stomachs and the relative quantities of each:

Table showing percentages of the different kinds of animal food found in Crows' stomachs, arranged by months.

Month.	Number of stomachs examined.	Rabbits.	Mice.	Mammals not identified.	Offal or carrion.	Wild birds and their eggs.	Poultry and their eggs.	Tortoises.	Snakes.	Frogs and toads.	Fish.	Crustacea (mainly crawfish).	Mollusca (mainly snails).	Insects and spiders.	Total animal food.
January...	53	.5	.....	......	17.5	trace.	.2	......	.3	trace.	.1	.2	.3	2.2	21.5
February.	23	.....	.2	......	6	......	trace.	......	......	.4	.1	......	trace.	3.3	10
March	26	.....	3.5	.2	1.2	......	1.1	......	......	.2	1.5	5.7	trace.	5.8	19.2
April	42	2	2.5	.1	.4	1.2	......	.5	trace.	3.6	1.7	.9	trace.	49.2	62
May	364	3	2.8	trace.	1.6	.8	1.1	1	2.3	3.4	.3	1.6	.1	47.9	67
June	165	.5	.7	.1	1.1	2.4	.5	.4	trace.	1.4	.1	.2	.2	40.0	49
July	45	.....	2.7	......	.2	2.2	.2	......	......	4.2	.3	.6	.2	26.5	37.3
August ...	24	.....	.4	......	.5	......	......	......	trace.	.2	.1	trace.	trace.	35.6	37
September	44	.....	.....	.1	1.6	......	.2	......	......	.3	trace.	.1	.2	24.6	27.1
October ...	46	.....	.1	......	.1	......	......	......	1	trace.	trace.	.7	.1	16.7	18.8
November.	18	.....	.2	......	3.2	......	.8	......	1.7	.2	.5	.2	.7	25.8	33.2
December.	59	.2	.1	.8	2.7	......	......	trace.	......	.3	.4	1.2	1.5	4.7	12.1
Average for year..	909	.5	1.1	.1	3	.6	.4	.2	.4	1.2	.4	.9	.3	23.5	32.9

For reasons already explained the annual average for each item of food in this table is obtained by averaging the monthly averages. Probably the most striking feature is the great importance of insects and spiders, which not only exceed any other single kind of food in all months except January and February, but the average for the year is more than double the combined averages of all other items. The next largest element is offal or carrion, and then follow successively frogs and toads, mice, crustacea, wild birds and eggs, rabbits, snakes, fish, poultry and their eggs, and various other materials.

Before proceeding to take up these separately it should be stated that the item offal or carrion as given in the table is incomplete, since it includes only such as could not be covered by any of the other headings. Almost every item doubtless includes some carrion, since it was often impossible to tell whether the animals found in a stomach had been killed by the Crow or were dead when picked up.

RELATION OF THE CROW TO MAMMALS.

RABBITS.

Remains of rabbits are common in Crow stomachs, particularly the common cottontail (*Lepus sylvaticus*) which must count the Crow one of its deadly enemies. It is not probable that adult rabbits are often attacked, but after the young begin to run about they are frequently pounced upon and carried away. On one occasion the writer saw a tragedy of this kind while driving along a Maryland road in June. A Crow suddenly sailed over the fence and alighted in the road about

100 yards ahead of the horse. As he lit, he struck savagely with his bill at some dark object on the ground which tried to escape by jumping from side to side, but the Crow followed each motion, striking quickly and heavily each time until the animal lay quiet, when, after a thorough pounding, the bird prepared to tear his quarry to pieces. Alarmed by the near approach of the wagon, he seized his prey in his bill and flew heavily over the bushes which fringed the road. Creeping to the fence I was able to identify the victim as a young rabbit, and subsequently found its tracks in the road at the point where the Crow had attacked it. My companion said that usually he had seen young rabbits at this place in the road for a week past, but this was the first time he had seen one attacked by a Crow.

Remains of rabbits occurred in 38 of the stomachs examined, and were most numerous in May, when they formed 3 percent of the entire food, 30 stomachs taken during this month containing an average of 37 per cent of rabbits (flesh, bones, hair, and teeth). These were almost invariably young, usually less than half grown. Of course it is possible that some were dead, but by far the greater number must have been caught and killed. In stomachs taken in April and June remains of young rabbits occurred to a less extent, but at no other season were any found.

A single stomach from Maryland, taken in December, contained remnants of an adult rabbit, and similar remains were found in a stomach from Argentine, Kans., collected in January. Mr. G. E. Stilwell, the collector of the last-named stomach, gives the following account of the capture of the rabbit by five Crows. He says:

"On January 2, 1891, I was at a small station called Zarah, after rabbits and birds, and was crossing some rough, stony hills where the snow was 3 or 4 inches deep. When on top of one of the hills my attention was drawn to some Crows making a great fuss about something, and so I crawled through the weeds and brush until I was in shelter of a stone fence and about 30 feet from the birds. I had a splendid view of the fight, which lasted about half an hour. The Crows took regular positions, one as a sentinel on a low tree over the others, one on the stone under which their victim was hiding, and the other three would walk as if about to go under the stone. The rabbit would try to come out, only to be driven back by savage pecks from the bird on the stone. When he was finally dead they began to peck his head as if eating. I did not wait any longer, but secured the sentinel and one other."

Another correspondent, in Livingston County, Mo., mentions the fact that Crows kill rabbits, but the habit seems to have escaped general notice, in spite of the fact that, as shown by the preceding table, rabbits enter more largely into the Crow's diet than poultry and eggs, of which he is supposed to be particularly fond.

MICE.

Except when the ground is covered with snow, mice form one of the more important articles of the Crow's food, ranking fourth in the list of items of animal food. The average for the year almost equals that of frogs and toads, and, with this exception, is exceeded only by insects and by offal or carrion. The average for the year is little more than 1 percent (1.108 percent), but in March the amount reaches $3\frac{1}{2}$ percent; in April and May it exceeds $2\frac{1}{2}$ percent, and though in June it falls considerably below 1 percent (0.7 percent), it rises again to $2\frac{7}{10}$ per cent in July. But these averages, taken by themselves, would be rather misleading, since they give little indication of the actual number of mice killed or devoured. The highest average in the table occurs in March; yet in that month only 3 stomachs out of 26, or less than 1 in 8, contained remains of mice, while in April 11 stomachs out of 42, or more than 1 in 4, showed such remains, although the average quantity in the latter month was only about two-thirds that in March. In May 47 Crows out of 364, or about 1 in 8, had eaten mice, while in July, with approximately the same average amount, only 4 out of 45, or 1 in 11, contained their remains.

A considerable number of the mice found in Crow stomachs should be considered as carrion. In many cases the odor was sufficient to indicate this fact; in other cases additional certainty was given by the presence of carrion beetles or burying beetles (*Silphidæ*) of several species. In many instances, however, these indications were useless, from the fact that the remains of several different animals were present in the same stomach, and it was impossible to connect the odor or the carrion beetles more closely with one than another.

It is probable that at least half the fragments of mice found in stomachs could be safely called carrion, but there is abundant proof from several sources that Crows often capture living mice, particularly the short-tailed meadow mice, which build their nests usually on the surface of the ground, among the roots of grass. Here the Crows discover them, and tearing the nest to pieces devour the young, and not infrequently catch the adults as well. By far the greater number of the mice found in the stomachs were meadow mice or voles (genus *Microtus*), and most of them were the commonest species (*Microtus pennsylvanicus*).

During the long winters of the Northern States, when snow covers the earth continuously to a depth of several feet, these meadow mice live in nests of dry grass on the surface of the ground, beneath the snow. Dr. C. Hart Merriam states that in northern New York the warmth of the nest and its contents causes the snow to melt around, and especially above, the nest, forming a dome-shaped chamber in the snow, which gradually increases in size until toward spring the snow roof falls in or melts away, leaving a hole through which the grass nest at the bottom may be seen. The Crows have learned to watch for these holes, and by descending suddenly and tearing the nest to pieces they often succeed in capturing the inmates.

That this habit is not confined to the Adirondack region is shown by a letter from Allan C. Brooks, of Chilliwack, British Columbia, in which he says: "In Ontario I have seen Crows working the fields for field-mice nests when the snow was about 6 inches deep and the nests were conspicuous by the round orifice through the snow caused by the warmth of the nest melting the snow above it."

Among the reports of other correspondents are eighteen or twenty which mention the fact that Crows eat mice. Since these give no additional details, it is unnecessary to do more than refer to them.

Not in early spring alone does the Crow hunt for the nests of field mice; he is always on the lookout for them, especially during the late spring and summer, when they are more likely to contain young. The Crow's habit of searching for food on the ground, and particularly of poking his bill into bunches of dead vegetation and under the roots of grasses and weeds in pastures and meadows, favors the discovery of these nests. Others are exposed by the mower, and constitute one of the many attractions that draw Crows to the hay field. Crow stomachs taken in July contain about four times as many mice as those taken in June. In meadow lands the mice and their nests are well hidden in June by the luxuriance of the grass, while in July they are exposed when the grass is cut. Besides the meadow mouse or vole (*Microtus*), remains of the common house mouse (*Mus musculus*) were found in many stomachs, and in several cases bones, teeth, and fur of the white-footed mouse (*Peromyscus*) occurred. In one instance four young Crows from a brood of five had been fed on a jumping mouse (*Zapus hudsonius*).

In thickly settled districts most of the other natural enemies of mice—hawks, owls, foxes, skunks, and weasels—exist only in small numbers, if at all, and the increase and spread of the house cat only supplies their places in part, and that at the sacrifice of vast numbers of small birds, to which the cat is extremely partial. The capture of each living mouse by the Crow is therefore an act of positive benefit to the agriculturist, and must be given due weight in trying to ascertain the Crow's economic status.

Crows in captivity evince the greatest relish for mice; in fact it is doubtful if any other article of food is so attractive. Even newly caged Crows, which refused to eat other food of any kind while watched, laid aside all fear when a mouse was shown them, and would crowd up to the bars and even take the mouse from my fingers, pecking savagely at each other in their eagerness to secure sole possession of the coveted tidbit. This experiment was repeated many times and with different Crows. It seemed impossible to gorge a Crow to such an extent that he would refuse a mouse. When a single mouse was given to several Crows the fortunate one that secured it was compelled to swallow it whole in order to prevent the others from seizing it, but he invariably disgorged it later and pulled it to pieces. Subsequently the hair, teeth, and some of the bones were disgorged as a pellet precisely as with hawks and owls, although in some cases most of the bones were ground up and entirely digested. It seems probable that this is rendered possible by the large amount of sand or gravel habitually swallowed after every meal, and the great muscular power of the stomach, which is practically a gizzard.

GROUND SQUIRRELS AND GOPHERS.

A few fragments of bones identified as those of a ground squirrel, presumably the eastern chipmunk (*Tamias striatus*) were found in one stomach. In this case it was impossible to tell with certainty whether or not the remains were carrion. The habits of the chipmunk make it improbable that the Crow often captures one alive, and then only in case the animal is very young. In the Mississippi Valley, where the striped ground squirrel (*Spermophilus tridecemlineatus*) is abundant, the Crow may capture the young occasionally, but the fact that these animals nest in burrows prevents the Crows from feeding on the young until they are able to run about.

Mr. William J. Howerton, of Florence, Pinal County, Ariz., states that he has seen the Crow of that region catching and killing the common pocket gopher (*Thomomys*). It is probable that this observation relates to the white-necked raven (*Corvus cryptoleucus*), as that is the commonest Crow of the region, although the true Crow (*Corvus americanus*) occurs there during migration. In any case, however, the Crow can not be regarded as an important enemy of this animal, since pocket gophers rarely appear above ground and it is not to be supposed that Crows are able to unearth them from their burrows.

One or two correspondents state that Crows destroy the young of arboreal squirrels, and this undoubtedly is true, although it can not be a very common practice.

BATS, MOLES, AND SHREWS.

Bones, teeth, and other vestiges of bats, moles, and shrews were found in twelve stomachs, all in May and June. But since the quantity of these remains for the year is less than one-tenth of 1 percent, they are of little economic import. It is possible that some of the shrews (remains of four individuals were found) may have been killed by the Crows, but it is much more likely that they were found dead, as must have been the case with the moles (*Scalops aquaticus*), two specimens of which were represented. Bats' bones or teeth occurred in six stomachs, but four of these stomachs belonged to nestlings of a single brood, and the remains were those of only a single bat.

UNIDENTIFIED MAMMALS.

Twelve Crow stomachs contained small quantities of fragments of small mammals which it was impossible to identify. These aggregated for the year only about one-twentieth of 1 percent (0.055 percent), at least half of which should be classed as carrion, so that the total is insignificant.

ATTACKS ON SHEEP AND SWINE.

It is well known that birds of prey are on the alert to discover sickly, wounded, or disabled animals. The Crow possesses this trait to a considerable degree, and although it does not often attack large animals until they are in a dying condition, there is reason to believe that it does so sometimes. Several correspondents state that it is guilty of these practices. Nevertheless, our efforts to secure authentic details of such cases have been unsuccessful except in a single instance. Mr. George A. Coleman, of London, Nebr., says that he was an eyewitness to a Crow's attack on a large live hog during a severe storm in the winter of 1881–82, when the corn was covered with snow and the Crows could not get at it. He did not see the first attack on the animal, but when he first saw the Crow on the hog's back it was tearing at a hole already 2 or 3 inches deep. The hog, a fat, heavy animal, was making strong but unsuccessful efforts to rid himself of his assailant. Hogs belonging to other farmers in the vicinity were reported to suffer in a similar manner. all, however, during the same winter and at about the same time.

A fair example of the newspaper reports on this subject is the following, recently clipped from the Kansas Live Stock Record:

"The ravenous Crows have destroyed two fine litters of pigs for me, picking them to death; and on Mr. A. J. Alexander's farm in Kentucky they have been feeding on his pigs, biting off their tails, ears, and even picking their eyes out."

In 1886 Mr. John S. Caulkins, of Thornville, Mich., wrote the Department as follows: "A grave accusation is made against Crows by some old farmers, who say they have known them to peck out the eyes of young lambs. I am inclined to think that in any such cases it would be found on investigation that the lamb was dead or dying before it was attacked by the Crows."

Prof. F. S. Place, of Alfred Center, N. Y., also wrote about the same time that Crows in his vicinity had been known to pick out the eyes of very young lambs.

RELATION OF THE CROW TO OTHER BIRDS.

Two serious charges are made against the Crow as regards its relation to other birds, namely, that it destroys the eggs and young of domesticated fowls, and is even more destructive to those of wild birds.

The evidence at hand sustains both. The testimony of observers is abundant and unimpeachable, yet it must be confessed that it gives an exaggerated idea of the extent of the evil. On the other hand, the examination of large numbers of stomachs, revealing comparatively few instances of these bad habits, tends perhaps to an underestimate of the evil. A comparison of the two sets of information and study of the combined data should give fairly trustworthy conclusions. The subject will be considered under two heads: (1) The destruction of eggs and young of poultry; (2) the destruction of eggs and young of wild birds.

DESTRUCTION OF EGGS AND YOUNG OF POULTRY.

This habit of the Crow has been well known for a century at least. The early settlers of eastern North America were much troubled by Crows, and took measures to lessen their numbers. Wilson, writing in the first decade of the present century, speaks of the Crow as "detected in robbing the hens' nests, pulling up the corn, and killing the young chickens," for which "he is considered as an outlaw and sentenced to destruction." Audubon, who was very favorably disposed toward the Crow and believed him to be a valuable friend of the agriculturist, omits all mention of his attacks on chickens or young poultry, but speaks with evident admiration of his skill in carrying off eggs.

Many good observers have described the Crow's methods in catching young poultry, but perhaps no better account has been written than that published more than sixty years ago by Dr. John D. Godman.[1] After years of careful observation, mainly in Anne Arundel County, Md., Dr. Godman says:

"Where food is at any time scarce, or the opportunity for such marauding inviting, there is scarcely a young animal about the farmyards safe from the attacks of the Crow. Young chickens, ducks, goslings, and even little pigs, when quite young and feeble, are carried off by them. They are not less eager to discover the nests of domestic fowls, and will sit very quietly in sight, at a convenient distance, until the hen leaves the nest, and then fly down and suck her eggs at leisure. But none of their tricks excited in me a greater interest than the observation of their attempts to rob a hen of her chicks. The Crow, alighting a little distance from the hen, would advance in an apparently careless way toward the brood, when the vigilant parent would bristle up her feathers and rush at the black rogue to drive him off. After several such approaches, the hen would become very angry and would chase the Crow to a greater distance from the brood. This is the very object the robber has in view, for as long as the parent keeps near her young the Crow has very slight chance of success; but as soon as he can induce her to follow him to a little distance from the brood, he takes advantage of his wings, and before she can regain her place, has flown over her and seized one of her chickens. When the cock is present, there is still less danger from such an attack, for chanticleer shows all his vigilance and gallantry in protecting his tender offspring, though it frequently happens that the number of hens with broods renders it impossible for him to extend his care to all. When the Crow tries to carry off a gosling from the mother, it requires more daring and skill, and is far less frequently successful than in the former instance. If the gander be in company, which he almost uniformly is, the Crow has his labor in vain. Notwithstanding the advantages of flight and superior cunning, the honest vigilance and determined bravery of the former are too much for him. His attempts to approach, however cautiously conducted, are promptly met, and all his tricks rendered unavailing, by the fierce movements of the gander, whose powerful blows the Crow seems to be well aware might effectually disable him. The first time I witnessed such a scene, I was at the side of a creek and saw on the opposite shore a goose with her goslings beset by a Crow. From the apparent alarm of the mother and brood it seemed to me they must be in great danger, and I called to the owner of the place, who happened to be in sight, to inform him of their situation. Instead of going to their relief, he shouted back to me, to ask if the gander was not there too, and as soon as he was answered in the affirmative he bid me be under no uneasiness, as the Crow would find its match. Nothing could exceed the cool impudence and pertinacity of the Crow, who perfectly regardless of my shouting, continued to worry the poor gander for an hour, by his efforts to obtain a nice gosling for his next meal. At length, convinced of the fruitlessness of his efforts, he flew off to seek some more easily procurable food. Several Crows sometimes unite to plunder the goose of her young, and are then generally successful, because they are able to distract the attention of the parents and lure them farther from their young."

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[1] Rambles of a Naturalist, 1833, pp. 65–66.

Similar quotations might be made from the writings of other observers, some assuming that the habit is common, or even universal, among crows, others that it is exceptional or confined to a few individuals. It seems probable that the latter view comes nearest the truth, since in many parts of the country the habit does not appear to have been noticed. We have corresponded with several hundred observers, representing almost every State and Territory in the United States, but in many cases no charges of chicken stealing have been brought against the Crow. The habit of egg stealing seems to be much more general, yet in numerous instances the reports are entirely from hearsay evidence. Unquestionably the Crow is very adroit in his attacks on young poultry, and it is probable that many of his thefts are unknown to the farmer, or are only suspected after frequent repetition. A single instance of such robbery will persist in a man's mind, and two or three are sufficient to convince the average farmer that the habit is universal.

More than 200 correspondents state that they have either seen or heard of damage to poultry and eggs by Crows, and about one-sixth of this number are positive that such damage is frequent and serious. On the other hand, more than 150 observers state that they have no personal knowledge of any such damage. Under such circumstances, especially if the reports are from localities where Crows are known to breed abundantly, it is impossible to avoid the conclusion that Crows rarely carry off young poultry; but in other localities it is equally certain that the habit is common.

The following statements from observers have been selected from more than 100 similar notes:

From John A. Weems, Flora, Bullock County, Ala.: The Common Crow is the worst egg thief I ever had to contend with. I never knew it to catch young chickens, but it destroyed at least 100 turkey eggs for me during last spring and early summer. 1886.

From C. L. Rawson, Norwich, Conn.: The Crow is a common enemy to the domestic turkey when breeding, frequently eating eggs and sometimes young. It ate 14 turkey eggs for a Preston farmer on June 1. I once saw a Crow flying with a duck egg in its bill, or rather with its bill thrust into the egg. 1886.

From Frank B. Hancock, Casky, Christian County, Ky.: Crows undoubtedly catch young chickens and steal eggs, and they have caused me more trouble in that respect than hawks. My home is situated on the south side of a woodland in which a colony of Crows located in 1870. This spring (1885) I have watched them carefully, and have seen them steal chickens before they were past the downy stage, and carry them away to their young. I have one Crow family charged with $25 worth of chicks stolen in April and May last.

From Dr. D. W. Prentiss, Washington, D. C.: Crows were observed to destroy young chickens frequently on farms at Moreland, near Adamstown, Md. This was well known to the farmers, and means were taken to protect the chicks. 1886.

From Prof. F. E. L. Beal, Lunenburg, Mass.: I have seen it catch at least one young chicken, and in several cases have had no doubt of its guilt. 1886.

From H. Nehrling, Freistatt, Lawrence County, Mo.: I have frequently observed them stealing the eggs from my poultry yard. They do this very slyly and quietly. As soon as the eggs are hatched they carry off the young chickens whenever they can get them. With the exception of Cooper's hawk, I do not know such a bold robber as the Crow. One day in April one of these birds perched on the fence, only a few steps from my house. An old hen with about a dozen chickens which were only a few days old was in my barnyard. Suddenly the Crow swooped down, caught a chicken with its bill, and went off, flying away near the ground. In a few weeks the Crows carried off about 20 chickens which varied in age from one day to four weeks. 1885.

From Dr. A. K. Fisher, Sing Sing, Westchester County, N. Y.: I have known Crows to carry off as many as 20 chickens from a single farm during a season. I have repeatedly observed them fly silently and perch on a tree near where the chickens lived, but in every case they were either killed or frightened away before any of the chickens were molested. 1885.

From F. L. Burns, Berwyn, Pa.: I have seen the Common Crow catch young chickens early in the spring when other food was scarce. It also steals chicken and turkey eggs, particularly when they have nests in a field near the woods. 1886.

From T. Scott Fisher, East Brook, Lawrence County, Pa.: If other food is scarce, the Crow will catch and eat young chickens until they are the size of a quail; it also eats eggs. I have seen it do both at least six different times. 1887.

From Witmer Stone, Germantown, Pa.: I have heard from reliable authority of Crows carrying off young chickens, but have never seen them do so myself. I frequently have seen them sucking the contents of turkey eggs, but only when the turkeys had laid in some retired place, not near the barnyard. 1886.

From Edwin B. Clark, Waxahachie, Ellis County, Tex.: I have known it to take young chickens and steal eggs in early spring, about March and April, particularly when the weather was very dry. I have never known it to do this except during the breeding season. The laying season here begins early in February and lasts until May. 1886.

Evidence furnished by stomach examination.—Traces of poultry or their eggs were found in 46 of the 909 stomachs examined. Twenty-one other stomachs contained bird remains which could not be positively identified as belonging to domesticated fowls, though in many cases this was probable. Allowing half these doubtful remains to have been those of poultry, we have a total of 57 stomachs, 6¼ percent of all examined, or about 1 stomach in 16. Of this number, however, 17 were taken in the months of January, February, March, September, and November, and the bird remains contained in these may be safely recorded as carrion or offal. The remaining cases occurred in May, June, and July, and presumably in most cases they can not be placed under the head of carrion or offal.

Table showing remains of poultry or eggs found in 616 Crow stomachs collected from April to July.

Stomachs examined.	April.	May.	June.	July.	Total.
Number of stomachs examined	42	364	165	45	616
Number containing poultry		11		1	12
Number containing eggs of poultry		15	2	2	19
Number containing unidentified birds		3	1		4
Number containing unidentified eggs		4	3		7
		33	6	3	42
Deduct stomachs counted twice					2
Total					40

This table shows that during the nesting season of the Crow, the time when the greatest damage to fowls and their eggs might be expected, only about 1 Crow in 15 had eaten either. Even this statement is too high, since 19 of the stomachs that contained remains of poultry belonged to young Crows taken from 6 nests.

Turning now to a consideration of the actual quantity of such food taken, it appears that the eggs and young of poultry form only a very small part of the Crow's food even during the nesting season. As already stated, such food was found in 40 stomachs taken during the breeding season and 19 of these were nestlings from 6 nests. The average quantity in each stomach was a little less than 12 percent (11.9). The average for all the stomachs taken during the breeding season, 616 in all, is only a little more than three-fourths of 1 percent (0.77), and the average for the year (909 stomachs) is a little over half of 1 percent (0.52).

DESTRUCTION OF EGGS AND YOUNG OF WILD BIRDS.

The older American naturalists speak of the Crow as one of the well-known enemies of the smaller wild birds. Audubon, after describing the Crow's attacks on the poultry yard, simply remarks: "It is as fond of the eggs of other birds as is the cuckoo."[1] Wilson[2] says: "In spring, when he makes his appearance among the groves and low thickets, all the feathered songsters are instantly alarmed, well knowing the depredations and murders he commits on their nests, eggs, and young."

Nuttall supposed the Crows of America, Europe, Asia, and even Australia to belong to one and the same species, and his remarks about their destroying eggs and young birds appear to have been based on a knowledge of the habits of the English Carrion Crow (*Corvus corone*), which is said to be particularly fond of the eggs and young of the European partridge. Dr. Brewer,[3] as late as 1874, wrote as follows: "They also occasionally commit depredations in the barnyard, robbing hens' nests of their eggs, and even destroying young chickens. They also destroy the eggs and young of other birds."

In 1867 Mr. E. A. Samuels, then State Ornithologist of Massachusetts, published, in his 'Birds of New England,' a somewhat lengthy discussion of the Crow's economic status, in which he threw out of the account every charge against the bird save that of the destruction of the eggs and young of wild birds, and yet concluded that the damage done in that way alone outweighed the good done in all ways combined at least 20 to 1. In making this estimate, which probably represents the extreme of exaggeration on this side of the question, Samuels states that he has seen a pair of Crows, in two visits to an orchard, within a half hour destroy the young birds in two robins' nests. This doubtless is perfectly true, for such occurrences are not very rare; but that does not justify the further statement that "it is perfectly reasonable to say that it destroys [each day in May] at least the eggs or young of one pair of sparrows, four in number; one pair of warblers, four in number, and one pair of thrushes or starlings, four in number."[4] It may be reasonably doubted whether any pair of Crows in America ever averaged anything like the above slaughter, even for a single week, while Mr. Samuels considers this only an average day's work for May, and allows double the amount for the whole of June and the first half of July.

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[1] Ornithological Biography, II, 1835, 319. Audubon, in common with a majority of writers on birds, credited the stories that cuckoos eat the eggs of other birds. The charge is a time-honored one, but from all the evidence now available, it seems to be groundless.—W. B. B.

[2] American Ornithology, Edinburgh ed., Vol. I, 1831, p. 245.

[3] Hist. North Am. Birds, II, 1874, p. 245.

[4] See also Rept. Comm. Agriculture for 1867, p. 207 and Samuels' Our Northern and Eastern Birds, 1883, p. 300.

In regard to the birds attacked, it is undoubtedly true that the smaller kinds suffer most.

In the American Naturalist for April, 1874, Caroline Boyce speaks of the Crow in eastern New York as follows: "The Crow commits fearful and cruel depredations on the robin and his belongings. The species is a bitter foe to all smaller birds, and keeps them in severe check."

Robert T. Morris wrote to Forest and Stream, in July, 1876: "By the time the young Crows are hatched [in New England and New York] the smaller birds are nesting, and it is at this season that the Crow is most destructive. The eggs and young of the smaller birds are appropriated by it on every opportunity for at least two months in the year. * * * I have known a pair of Crows to destroy the young in three robins' nests in one day."

In the August number (1876) of the same journal Oliver D. Shock, of Hamburg, Pa., wrote: "In the spring, when other birds are building their nests * * * the insectivorous tribe suffer most severely from these black marauders, as no sooner does the Crow find a nest than it pounces on the innocent occupants, and be they eggs or birds they will be devoured. * * * I have frequently seen them near my residence, on the banks of the Schuylkill River, pounce down upon an innocent robin sitting upon her nest, make her abandon it, and then gobble up the nestful of embryo songsters."

These visits are not always seen, as the Crow approaches the nest either by stealth or by sudden assault during the absence of the parent birds, well knowing that by so doing he avoids the attacks of the nest owners and their friends and sympathizers. The smaller sparrows, finches, and warblers are unable to make much resistance, but the Crow prefers larger eggs and young, and the attacks of robins and blackbirds, especially when several pairs combine, are not to be despised. The following account by Montague Chamberlain, of St. John, New Brunswick, illustrates a form of strategy to which the wily Crow sometimes resorts: "I was attracted to a bunch of trees by a commotion among a troop of robins, and discovered some six individuals fiercely attacking a Crow, a second black form being detected skulking some little distance away. Presently Crow No. 1 flew off, followed by the entire mob of excited redbreasts, when Crow No. 2 made a dash into the trees, and emerged with an unfledged robin grasped in his dexter claws, the youngster kicking and piping lustily. The cries brought back the guardians, who at once gave chase to the captor, and while they were off in one direction Crow No. 1 charged the nest from an opposite point, and retired with another of the brood firmly held in his claws." (The Auk, I, 1884, p. 92.)

Accounts of similar attacks on small birds have been received from correspondents with considerable frequency. One of the recent reports came from F. R. Welsh, of Philadelphia, Pa., in a letter dated May 29, 1893. It is as follows: "Yesterday afternoon I was attracted by the cries of a young robin and some old robins and blackbirds. Running toward an evergreen from which the cries came, I saw a Crow fly out with a young robin in its bill. Three old robins chased it a short distance, and the blackbirds for about 300 yards, when the Crow lit on a fence, but did not drop its victim. In the evergreen I found a robin's nest containing one young robin apparently dead, but still warm. There was a drop of blood on a branch below the nest, but I could find no marks of injury on the young bird in the nest. * * * When the nest and vicinity were examined again two hours later no sign of the young bird could be found. Probably the Crow took it also."

The frequency with which the robin is mentioned in the reports of correspondents indicates that it is peculiarly subject to the attacks of the Crow, in spite of the fact that robins nest most commonly in the orchards and shade trees near houses. In attacking such nests the Crow is likely to come early in the morning, evidently because it has learned that at such a time he is least likely to suffer from human interference. The same fact has been observed in regard to the attacks on chickens and on corn planted near houses.

It is well known that several kinds of wild birds prefer the neighborhood of houses when nesting, and as a rule such species increase rapidly with the settlement of a region. This has been attributed in part to the increase of food supply and in part to the immunity secured from natural enemies, of which the Crow is one.

Crow blackbirds unite to attack a Crow, but the enemy often escapes without injury. Robins, too, combine to punish the despoiler of their homes, but they seldom follow the thief far, and probably their bills are too weak to be very serviceable in such skirmishes.

It seems probable that originally the robin, like most other birds, secured the safety of its nest by hiding it from its enemies. Mr. Martin Trippe says: "The breeding habits of birds undergo considerable modification on the settlement of the country. In the wilds of Minnesota I never saw the nest of the robin elsewhere than in the tops of the tallest Norway pines. The Crow in similar localities often builds on low bushes."

It is true that even now the robin frequently hides its nest successfully in the thickest part of some evergreen tree, but in many, perhaps most, cases no such concealment is attempted. This neglect of concealment is sufficient to account for a large proportion of the cases in which the cat-bird, mocking bird, brown thrasher, and crow blackbird are the victims. From the concentration of these birds in the orchards, shade trees, and shrubbery about houses, the robbery of their nests is more often witnessed, and doubtless this fact leads to an overestimate of the harm done by the Crow to small birds in general.

After the young of the smaller birds are out of the nest, and before they are able to care for themselves, the Crow doubtless picks them up whenever possible. Mr. Charles A. Davis, of Burlington, Vt., wrote in 1885 that he had seen Crows catch and carry to their nests 8 or 10 young bank swallows which were feathered out. In the summer of 1889 the writer saw a Crow start from the top of a high tree in pursuit of a meadow lark (probably young) which was crossing the field below. The Crow almost reached its intended victim before the latter was aware that it was followed, but by a vigorous use of its wings, and much sharp dodging and twisting, it finally escaped, though the chase lasted several minutes.

Dr. W. S. Strode, of Bernadotte, Fulton County, Ill., wrote to the Department as follows: "On April 20, 1888, a farmer from the prairie south of town reported to me that the Crows were killing prairie hens on his farm, chasing them till worn out and then killing and eating them."

It is well known that the nests of game birds are occasionally plundered by Crows, but except under unusual circumstances the harm is not serious. As a rule it may be assumed that our native game birds are able to hide their nests so as to escape the keen eyes of the Crow. Those which lay light-colored eggs, as the bobwhite, probably run most risk, but the parent birds are protectively colored, and the eggs are seldom left uncovered for any length of time. The nests of waterfowl are subject to the attacks of Crows, which hang about the breeding places, always ready to take advantage of any emergency which may expose the eggs or young. In some cases waterfowl evidently depend upon their own presence in numbers to prevent loss, and many species carefully cover their eggs with leaves, moss, or other substances, when they leave them, so that they are not readily discovered.

In the case of most birds nesting in colonies, however, some loss is likely to occur, and occasionally the persecution by Crows may be sufficient to break up the colony, as in the following instance related by Mr. A. G. Van Aken:[1] "About ten pairs of night herons (*Nyctiardea grisea*) and three pairs of little blue herons (*Ardea cœrulea*) have nested for a few years within the corporate limits of the city of New Brunswick, N. J. When I visited this heronry late in April, 1882, I discovered that one nest already contained four eggs, two others each three, several more one and two, while the remainder were as yet empty. About two weeks later, after climbing up to a number of nests, and passing from the top of one tree to another, where this was practicable, thus examining nearly all, I was surprised to find each empty, though the old birds fluttered overhead or alighted near by. At the base of many of the trees in which nests were situated lay the eggs with pieces broken out and the meat gone. I suspected two parties of the robbing, either the red squirrel (*Sciurus hudsonius*) that I saw some distance away, or else a number of Crows that were perched in a neighboring tree cawing lustily. On May 20 I examined the nests a third time, finding them again without eggs, while fresh shells were strewn on the ground.

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[1] Ornithologist and Oologist, Vol. VIII, 1883, pp. 46–47.

"The herons were now shy and restless, whereas the Crows, for whom I entertained a strong aversion, were more audacious and clamorous than ever. A subsequent and final visit revealed conditions unchanged, the Crows as officious as ever, so that it being very late in the season, I was satisfied that no young birds were reared last year."

Accounts of similar depredations on heronries are by no means rare, but although the eggs and young herons doubtless constitute the primary attraction at such breeding places, it is probable that the Crows get the fish and other food accidentally dropped by the herons while feeding their young, as herons are notoriously careless in this respect. The following account[1] by Mr. J. Foster, of the plundering of Florida rookeries by Crows illustrates forcibly the intelligence of these dusky thieves, and their readiness to take advantage of circumstances:

"In the years of 1874 and 1875 a party of us made two round trips to Lake Okeechobee, Florida, by way of the Kissimmee River. We also took a third hunt as far as Fort Kissimmee. In these voyages it was very interesting to observe the habits of the Crow. All the herons and water turkeys (darters or snakebirds) had built in the hummock adjoining the water. Whenever our boat, the *Forest and Stream*, suddenly rounded a point there was a great stir in the rookeries and a lively time for the Crows. The latter birds seemed to know our movements, for they were ever on the alert at every disturbance, and began actively to plunder the nests, robbing them of both eggs and young birds. When we came to a rookery of plume birds our guns created great confusion among the herons; but the Crows seemed to take in the situation, and apparently understood our intention, for they paid no attention to the noise of our guns, but plied their work of destruction upon the eggs and young as mercilessly as did we upon the old birds. As long as we continued shooting they made havoc among the nests."

Herons, ducks, and most other waterfowl are not quick enough on the wing to drive the Crows away and thus secure safety for their nests. Sometimes, however, Crows attempt to impose upon species which are able to defend themselves.

Mr. B. H. Dutcher gives the following account[2] of the persecution of four Crows by terns on a small island at the eastern end of Long Island Sound in August, 1888: "Four unlucky Crows sometime in the spring, before the terns arrived, decided to take up their residence on Great Gull Island. * * * It might have been that they came in search of food, for the island was well stocked with the eggs and young of the terns. If so, they were sadly disappointed, for no sooner had the terns arrived than they fell on the crows and persecuted them relentlessly, until we put an end to their misery. Leave the island they could not, for did one attempt to rise a horde of terns was at him almost before he had risen above the grass, and screaming, diving, and dashing at the unfortunate bird would soon drive him back to the earth again, and then, as if not content with that, would continue to worry him long after he had settled down. The Crows were in a sorry plight, indeed, for the terns, not satisfied with worrying their victims at a distance, even went so far as to peck out the poor birds' feathers; and between the exuviæ that the terns had dropped on them, and the light patches where the feathers had been picked out, the Crows presented a rather mottled appearance. From the upper mandible of one Crow a piece of the sheath and bone, half an inch long and an eighth deep, had been gouged out, undoubtedly by the lower mandible of a tern. This incessant persecution had rendered the Crows so tame that we could always approach to within 25 feet of them before they would fly, and Charles B. Field told me that on one occasion he caught one in his hand, the bird preferring rather to be caught by the man than to be chased by the terns."

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[1] Forest and Stream, VII, 1876, p. 84.

[2] The Auk, VI, 1889, pp. 129–130.

Summary of evidence furnished by stomach examination.—Of the 909 Crow stomachs examined only 41 contained eggs, feathers, bones, or other remains which could be identified certainly as those of wild birds. Twenty other stomachs contained remains which may or may not have belonged to wild birds. Half of these have been added to the wild birds, while the remainder have been referred to poultry. A single stomach taken in January contained two vertebræ of a small bird, doubtless found dead by the Crow; but with this exception all the remains of wild birds were in stomachs taken in April, May, June, and July. During these months 616 stomachs were collected. The following table shows the number which contained remains of wild birds or their eggs in each month:

Table showing number of Crow stomachs containing remains of wild birds or their eggs.

Month.	Number of stomachs examined.	Number of stomachs containing— Wild birds.	Eggs of wild birds.	Unidentified bird remains.	Unidentified eggs.	Total.
April	42	2				2
May	364	16	5	3	4	28
June	165	9	7		3	19
July	45	2				2
Total	616	29	12	3	7	51
Deduct stomach counted twice						1
						50

The above table indicates much less injury to wild birds and their eggs than has been supposed. It appears that the injury is confined to young birds and eggs, and consequently occurs only during the breeding season, or from April to July. It is shown further that during this time, on an average, only 1 Crow in 12 eats any young birds or eggs, and even this proportion is much too high, as will be clear from a consideration of the fact that 38 of the stomachs containing remains of birds or eggs were those of Crow nestlings, and 25 of these were from 9 nests, containing 2 to 5 young each. Since in most cases a single bird is torn in pieces and divided among all the young in a nest, it is evident that the number of birds destroyed has been greatly overrated. Furthermore, of the 12 stomachs remaining, several belonged to the parents of the above nestlings, so that the number of Crows actually concerned in destroying the young and eggs found in these 50 stomachs could hardly have been more than half of 50, and it seems probable that not more than 1 Crow in 20 ever becomes addicted to this sort of stealing.

It should not be inferred that birds and eggs are specially sought for as food for nestling Crows. The fact that many more young Crows than old ones were collected during the summer months, and that a single bird is usually divided among the young of a nest, accounts for the larger number of young stomachs containing such food. As a rule, when feathers, eggshells, or other bird remains occurred in the stomach of one nestling in a brood they occurred in all, and in most such cases the remains in the several stomachs were all referable to a single victim, showing that the parents must have divided the food pretty evenly among the young. In several cases two or three members of a family had received food of a totally different character from that furnished the rest, and occasionally one or two stomachs were well filled while the others from the same nest were but partly filled or almost empty, but this was very unusual. Young and rapidly growing Crows need a larger proportion of animal food than adults, and in case such food is scarce it is possible the parents give a larger share to the young, contenting themselves with food more easily obtainable. It is noticeable that of the stomachs containing eggs a large majority were from adult Crows, while the remains of fledgelings occurred most frequently in the young. The probable explanation is that old Crows find it difficult to carry eggs without breaking, especially as they are so often attacked and worried by the birds robbed.

In the case of eggshells the estimated percentage undoubtedly is too small, for the shell commonly formed only 1 or 2 percent of the stomach contents and the soft parts of the egg had disappeared completely.

The actual quantity of bird remains found in the stomachs is comparatively small. In very few cases did it form as much as half of the entire stomach contents, though in one or two stomachs it exceeded that proportion. The average for the 50 stomachs was about 18⅓ per cent, or only 1½ percent for the 616 stomachs taken during the season. The average annual amount in the 909 stomachs was almost exactly 1 percent.

In regard to the kinds of birds found in the stomachs, it was possible to determine but little. Nestlings, especially when very small, are not easily identified under favorable conditions, while it is almost impossible to name them after they have been plucked, dismembered, and partly digested. Occasionally a piece of a skull, the tip of a bill, or a more or less complete foot would justify a guess at the family or genus to which the victim belonged, and in a single case a few characteristic feathers, together with the early date (April 22, at Washington, D. C.), made possible the identification of the species—a young meadow lark. One stomach contained, among other remains, the stomach lining of a small bird, and doubtless the food originally contained in the small stomach had mingled with that properly belonging to the Crow. Another stomach contained nearly the whole of a small bird, including the entire stomach, which still inclosed considerable food, mainly parts of insects and their eggs. In neither case was it possible to identify the bird to which the stomach belonged.

The eggshells found in Crow stomachs could not be identified absolutely in any case, but they yielded .some interesting indications. In two cases the shells were those of either the robin or the wood thrush, and in another case probably belonged to the cat-bird. In five other stomachs the shell fragments were thin and distinctly blue but in such small bits that it was impossible to determine whether they were spotted or not. It is probable, however, that most of these eggs belonged to robins, cat-birds, or thrushes.

RELATION OF THE CROW TO REPTILES, FISHES, AND INVERTEBRATES.

DESTRUCTION OF REPTILES.

Tortoises.—The examination of Crow stomachs brought to light the somewhat unexpected fact that Crows destroy considerable numbers of young tortoises—or terrapins as they are generally called in Maryland and Virginia. This item of food is noticeable during April, May, and June. Only young tortoises are eaten, those of very small size predominating, though occasionally larger ones are taken. From lack of material for comparison it was not practicable to identify all the species represented, but fragments of the snapping tortoise (*Chelydra serpentina*) were most abundant, although the painted tortoise (*Chrysemys picta*) and the box tortoise (*Cistudo carolina*) also occurred frequently. In many cases every trace of tortoise flesh and bones, and even the shell, had disappeared from the stomach, leaving only the horny tips of the jaws, which appeared to resist both the grinding action of the stomach and the dissolving action of the digestive fluids. Many, perhaps most, of the tortoise remains were in the stomachs of nestlings, and in one instance an old Crow, shot as she was approaching her nest, dropped a small tortoise.

Since this kind of food was taken only during one-fourth of the year the annual average is very small—only about one-sixth of 1 percent of the food—but in May it formed almost 1 percent, occurring in 33 stomachs out of 364, or in about 1 stomach out of every 11. The average in the 33 stomachs was 10.5 per cent. In April the remains were found in about one-eighth of the stomachs, but the average quantity was smaller in May, and still less in June. One stomach taken in December contained 2 percent of tortoise remains, evidently carrion.

The following statement from Mr. John M. Richardson, of Daingerfield, Tex., is of interest in this connection, as it was published at a time when the extent of the Crow's depredations on these reptiles was entirely unsuspected by us (Annual Report Dept. Agriculture for 1888, p. 524). Mr. Richardson, who seems to be the only correspondent who has noticed this habit, says:

"The Crow is known to catch young terrapins, and there is reason to believe that it destroys other small reptiles. I remember a rock-crowned hill on the east bank of the Wateree, between Manchester and Statesburg, in Sumter County, Ga., that was almost covered with remains of small terrapins and land tortoises carried there and devoured by Crows."

Snakes and lizards.—Crows eat many snakes, some of which they kill. Mr. B. T. Galloway, chief of the division of vegetable pathology of the Department of Agriculture, details a battle between a Crow and a large snake (at least 3 feet long) which was witnessed near his house at Garrett Park, Md., during the summer of 1893. The Crow not only struck the snake repeatedly with his bill, but lifted it from the ground and beat it with its wings, the snake meanwhile writhing, twisting, and attempting to bite its antagonist. The fight lasted half an hour or more, and eventually the snake was killed and partly eaten. A singular feature of this combat was the fact that one Crow did all the fighting, although several others watched the struggle from a neighboring fence. The following account of a similar battle appeared in the Ornithologist and Oologist[1] for February, 1883, and seems to have been written by the editor, Joseph M. Wade: "While riding down through Occum, Conn., on May 26 last (1882) we noticed a Crow on a level garden bed killing a snake which was not less than 18 inches long. The snake seemed fully conscious of what was going on and tried to get away, but showed fight every time it was seized. It was interesting to see the Crow bite him, lift him up, and throw him to the ground, keeping one eye on us the while. This went on for some time, the snake getting weaker every bout. The Crow evidently not liking the nearness of myself and carriage, seized the snake within a few inches of its head and flew with it into the large trees beyond the Wequonock River where we could not watch its further operations. The snake hung down its full length while being carried over the river."

Reports from correspondents in Ontario, Massachusetts, Connecticut, New York, Maryland, Virginia, Kentucky, Kansas, and Texas show that in all those localities the Crow preys regularly on snakes either dead or alive, and there is no reason to doubt that its habits are the same in this respect everywhere throughout its range. The stomachs which contain remains of snakes represent most of the States already mentioned, also Georgia, Florida, and Wisconsin. Probably half the ophidian remnants in these stomachs were carrion. but the exact proportion is not determinable. The annual average is about half of 1 per cent (0.45 percent), but the average for May reaches $2\frac{1}{4}$ percent, and during this month at least 1 stomach in every 6 contained remains of snakes, the average for the 62 stomachs exceeding 13 percent. It is not probable, however, that the remnants in these stomachs represented as many as 62 snakes, for in many cases a single snake sufficed for an entire brood of young, and it rarely happened that parts of a snake were found in one stomach of a brood and not in the others.

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[1] Vol. VIII, No. 2, Feb., 1883, p. 11.

It can hardly be claimed that in killing snakes Crows do any good, and it may be fairly questioned whether some real harm is not done. If the snakes were poisonous the case would be different, but so far as observed all the victims were harmless species, most of which feed largely on insects, mice, frogs, and similar food, the consumption of which is advantageous, or at least not detrimental to the agriculturist. On the other hand, the black snake and some other kinds destroy insectivorous birds and eggs. But it is probable that most of the snakes eaten by crows are carrion, killed by man, not by Crows.

Crows eat a few lizards, but under ordinary circumstances they are too active to be caught easily, and their protective coloration is an additional safeguard. In the Northern United States lizards occur sparingly or not at all, but from Maryland southward they are fairly abundant; still, among several hundred Crow stomachs from the Southern States traces of lizards were found in only one. A single stomach, taken at Sandy Spring, Md., in May, contained the bones of a small lizard (probably *Sceloporus undulatus*).

Frogs and toads.—No animal food occurs more regularly in Crow stomachs than remnants of frogs and toads. Toads are notoriously clumsy and unfortunate, and it may be presumed that many, if not most, of those found in the stomachs of Crows had been stepped on or otherwise injured, and subsequently appropriated by the sable scavengers. Frogs, on the other hand, rarely suffer from accidents of this kind, and probably most of those eaten by Crows are captured alive. The great abundance of frogs in most places accounts in some measure for the frequency with which they are captured.

It has been supposed that the peculiar acrid secretion of the skin of the toad is a protection against natural enemies; and it has been observed that few dogs can be induced to bite a toad. and after one attempt they usually refuse to renew the attack, showing unmistakably by their actions and by the free flow of saliva that the toad's secretion is very unpleasant, if not actually painful. Whether or not this secretion is distasteful to Crows is unknown, but it is certain that Crows consume large numbers of toads and frogs. In many cases the warty skin of the toad has been found in the Crow's stomach, showing conclusively that it is not discarded when the rest of the victim is swallowed.

Remains of frogs or toads were found with greater or less frequency in stomachs collected during every month in the year, the aggregate being 151 stomachs out of a total of 909 and the average proportion of the food for the year 1.2 percent. The greater number of these batrachians were eaten in April, May, June, and July, the average for these months being: April, 3.6 percent; May, 3.4 percent; June, 1.4 percent; July, 4.2 percent. During these four months frogs and toads formed 3.2 percent of the food of the Crow, a larger amount than any other single item of animal food except insects. In April this food was found in 9 stomachs out of 42, or about 1 in 5; in May it occurred in 99 out of 364, or about 1 in 3½; in June the number was 27 out of 165, or about 1 in 6, and in July, 6 out of 45, or nearly 1 in 7. During the remainder of the year the amounts were insignificant.

Most of the remains belonged to the common toad (*Bufo*) and various species of frogs (*Rana*), but several stomachs contained bones of tree frogs (*Hyla*).

As to the good or harm resulting from the Crow's consumption of frogs and toads, several points should be considered. Toads are mainly insectivorous, and consume immense numbers of insects, often of the most injurious kinds. Therefore, whenever the Crow kills a toad it is inflicting direct loss on the agriculturist. Frogs, likewise, are purely carnivorous, and consume large numbers of insects; but from their restriction in the main to marshy ground and the immediate vicinity of water the insects they are able to catch are of much less economic importance than those eaten by toads. On the other hand, the Crow certainly kills more frogs than toads, and as little harm, but some good, is done by frogs, the balance, on the whole, is unfavorable to the Crow.

Newts, efts, or salamanders.—These harmless little animals, so often confounded with lizards, form one of the minor items of the Crow's food. They occur all over the United States, except in the arid regions, and in favorable locations some of the smaller species are met with in large numbers. All live in wet, or at least damp, situations, and some pass their entire lives under water.

The Crow's habit of turning over small stones, chips, and the like favors the discovery of these little amphibians. The largest species found in the stomachs (*Desmognathus fusca*) did not exceed 4 inches in length, and most of those discovered were scarcely half as large. Consequently, even if eaten in considerable numbers, they do not form any large part of the food, since the average for the year amounts to less than one-tenth of 1 percent. In May 34 stomachs out of 364, or 1 in

11, contained their remains, and in June the proportion was about 1 in 12. In some cases the remains of as many as a dozen salamanders were found in a single stomach, but usually fragments of but one or two occurred, and the ratio seldom exceeded 10 percent, the average for 52 stomachs being less than half this amount—4.8 percent.

The habits of these salamanders are but imperfectly known, but they are supposed to feed mainly on animal substances, in part insects. Their economic importance is insignificant.

DESTRUCTION OF FISH.

Parts of fish of various kinds were taken from 46 of the 909 Crow stomachs examined, and the average amount in these 46 stomachs was about 6 percent. The average percent of fish in the year's food was less than half of 1 percent, and in only two months, March and April, did it exceed 1 percent. Most of the fragments found were unquestionably parts of dead fish, and therefore, so far as present purposes are concerned, might be merged with carrion or offal, although sufficient evidence is at hand to show that at least some Crows are able to catch fish for themselves. The first record of this habit, so far as we are aware, was published by Dr. Edgar A. Mearns in 1880.[1] The note relates to Highland Falls, N. Y., and is as follows: "Crows are expert fishers. In winter they watch at the fissures in the ice alongshore at low tide, and claw out whatever fishes are passing. I have known two Crows to capture upward of 20 good-sized goldfish (*Crassius auratus*) in less than an hour's time."

The following observation by Mr. L. I. Flower, of Clifton, New Brunswick, was published[2] by Montague Chamberlain in 1884. "A few years since, while crossing the Washadermock Lake, I noticed a Crow flying close to the surface at a spot where the water is very shoal. Suddenly, when but a short distance from my boat, the Crow thrust his claw down into the water and drew to the surface what I afterwards discovered was a fish of about half a pound weight, and then seizing it with his bill, by aid of 'tooth and nail' succeeded in drawing it out of the water and carrying it to an adjacent rock, the fish all the while struggling hard to get free.

DESTRUCTION OF CRUSTACEANS.

Crustaceans are prominent in the food of Crows at all seasons, standing fifth on the list showing relative percentages of the animal food of the year. The annual average amounts to nearly 1 percent (0.95 per cent). Out of the 909 stomachs examined, 137 contained remains of *Crustacea*, and in all but 14 cases these were crawfish. In January the only remains were those of 'sow bugs,' or 'pill bugs' (*Oniscus*), which occurred in four stomachs. These are terrestial crustaceans abundant in damp places, and were found in stomachs of Crows shot near garbage heaps in the vicinity of Washington. In March, October, and December, the remains consisted mainly of marine crabs, doubtless thrown up by the sea, and captured dead or alive by the Crows along the seashore. One stomach taken in December contained barnacles amounting to 40 percent of the contents. This food, except the crawfish, has no economic significance, and the greater part may be safely counted as carrion or offal. Crawfish, on the other hand, are capable of doing considerable damage, particularly by tunneling dams or embankments, and by throwing up mud 'chimneys' on low grass lands. It is by no means certain what proportion of the remains found in stomachs should be regarded as carrion, but since fragments of crawfish occurred in 123 stomachs it is extremely probable that the Crows have learned where and how to catch these crustaceans alive. In the month of May 83 stomachs, or almost 1 in every 4, contained their remains, the average for these exceeding 7 percent, while the average of all the stomachs, that is, the percentage of the entire food for the month, was a little more than 1½ percent (1.6 percent). No other month shows so large a record of crawfish, although in April they were found in 9 stomachs out of 42, and the average for the 9 was over 4 percent.

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[1] Bull. Essex Inst., Vol. XII, 1880, p. 109.

[2] The Auk, Vol. I, 1884, p. 391.

Of course Crows on the seashore get large numbers of crustaceans, both alive and thrown up dead by the waves, but in general the consumption of this food has little bearing on the economic status of the Crow.

DESTRUCTION OF MOLLUSKS.

The presence of mollusks in the stomachs of crows was determined in most cases by fragments of their shells, and the utmost care was necessary to determine in each case whether these bits of shell were parts of entire animals taken as food or simply part of the gravel so generally swallowed to aid digestion. As a rule the latter was assumed to be true whenever the fragments had worn edges, otherwise the former. Sometimes entire snails were found, and occasionally large fragments of fresh or salt water bivalves, but in the majority of stomachs no such decisive matter was present.

Among the Crows taken at a distance from the sea the traces of mollusks were confined to land snails (mainly *Helix*) except in one or two cases where fragments of shells of fresh-water mussels (*Unio*) occurred. Crows have been credited pretty generally with the habit of lifting clams, mussels, and other shellfish high in the air and dropping them on hard objects in order to break the shells and get at the contents. An observation on this subject illustrating the acuteness and intelligence of the Northwest Fish Crow (*Corvus caurinus*) was published by H. W. Henshaw in the Youth's Companion, January 9, 1890. Mr. Henshaw says:

"Some years ago, while wandering along the shores of Puget Sound, in what was then Washington Territory, I noticed a flock of Fish Crows flying out to a small island which the ebbing tide was just revealing. Each one in turn seized some object in his bill, and flying to the rocky shore dropped it on the rocks, and then descended to feast upon it.

"Investigation showed that the objects were mussels. Instead of hammering the shells open, which would have cost time and labor, the Crows, in order to get at the contents, resorted to the easy and expeditious mode of letting the mussels fall on the rocks.

"No doubt the trick was learned by accident, as many an important invention of man has been. A flying Crow accidentally dropped a mussel on the rocks, and noting the result repeated the experiment to his own and his observing relatives' profit; and so in time, through inheritance, the habit became fixed among Crows.

"At the same place I observed a herd of hogs rooting in the beach at the water's edge, and as I paused to note what they were about, presently along came several Crows. To my amazement they flew, one to each pig, and perched on the head between the ears.

"From this lookout each Crow kept a bright watch on the hog's snout, evidently on the qui vive for whatever should turn up, and not for a moment was his attention diverted.

"Presently one of the hogs rooted up a razor clam, when immediately down pounced the alert, but unprincipled Crow, seized the prize, and made off to devour his ill-gotten booty at leisure. The stupid, but honest and hard-working porker renewed his labors, apparently with no sense of his loss, and at all events with no visible signs of resentment against the robber; but as long as I played the part of spectator no razor clam fell to the lot of the pigs."

The amount of sea food in the stomachs examined was comparatively small, and the annual average of the single item, mollusks, was little more than one-fourth of 1 percent. Even the relatively large amount in December (about 1½ percent) is due to the presence of an unusual quantity (55 percent) in a single stomach, the average in 8 other stomachs amounting to only 3 percent.

Beside the crustaceans and mollusks, remains of a few other invertebrates were found, but only two or three need be mentioned. Myriapods—all millipeds—occurred in perhaps a dozen stomachs, but always in very small numbers, the amount exceeding 1 percent in only a single instance. A small leech was found in 1 stomach, and earthworms in 9. One of these stomachs contained 63 percent of earthworms, and another 33 percent, which, with the additional fact that no vertebrate remains appeared in either case, makes it reasonably certain that the worms were eaten intentionally. Three other stomachs, from young Crows of one family, contained, respectively, 2, 7, and 25 percent of earthworms. The remaining 4 stomachs, all from one nest, contained about 1 per cent each of setæ of earthworms, but as these were associated with the remains of a shrew, a snake, a frog, and a newt, all of which animals (with the possible exception of the snake) are known to eat earthworms with avidity, it seems probable that the earthworm bristles may have been derived from the stomach of one of the included animals. It is a noteworthy fact that Crows in following the plow have been seen to leave the earthworms untouched, although greedily eating white grubs and other larvæ exposed in the furrow. Moreover, according to my experience, Crows in confinement usually refuse earthworms, and never show any great relish for them. Young Crows repeatedly rejected earthworms when put in their mouths, and unless pushed far down their throats they absolutely refused to swallow them.

As illustrating the fondness of the Crow for food hidden within hard outer coverings or shells, and the further fact that a given item may form a large part of a Crow's food in one part of the country and not in another, the following note by J. Walter Fewkes[1] is of interest:

"Near Eastport, Me., there is known to be a considerable deposit of the broken tests and half decomposed soft parts of our common New England sea urchins (*S. drœbachiensis*) far removed above the level of high water.

"This deposit is formed in the main of fragments of the solid tests of these echinoderms, which are said to have been carried there alive by Crows, which frequent the locality in great numbers."

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[1] The Auk, Vol. I, 1884, p. 92.

CHAPTER III.

INSECT FOOD OF THE CROW.

The matter of the Crow's utility as an insect destroyer is one of prime importance; in fact, it is the crucial test of the bird's value The material available for the decision of this question consists of the insect contents of 909 stomachs, taken at various places and times, the great majority during the warmer half of the year.

Most of the older ornithologists recognized the fact that Crows ate insects in considerable numbers, but ignored the fact that many insects are beneficial; and moreover they took no pains to determine what proportion of the Crow's diet consists of insects. Even at the present time these points are very generally overlooked, and to the best of our knowledge there is nowhere a record of the carefully identified contents of a dozen Crow stomachs taken in summer. A few naturalists have put on record the results of more or less thorough examinations, but in too many cases we find only such general statements as 'contents consisted of seeds, berries, and insects,' or possibly of 'grain, carrion, and beetles,' without any attempt to determine the kind or amount of each.

Eight hundred and one out of 909 stomachs examined contained insect remains in quantities varying from the merest trace to 100 per cent. The following table shows the number of Crow stomachs collected during each month, the numbers which contained insect remains, and the average percentage of such remains for the whole number of stomachs in each month:

Table showing average percentages of insect material contained in 909 Crow stomachs, arranged by months.

Month.	Number examined.	Number containing insects.	Percentage of insect contents.
January	53	21	2.2
February	23	10	3.3
March	26	16	5.8
April	42	36	49.2
May	364	357	47.1
June	165	157	40
July	45	42	26.5
August	24	24	35.6
September	44	40	24.6
October	46	42	16.7
November	18	17	25.8
December	59	39	4.7
Total	909	801	23.5

It appears from this table that the average quantity of insect material in these 909 stomachs was almost 24 percent. A moment's examination of the table shows, however, that the number of stomachs examined in different months is very unequal, and also that the percentage varies widely according to season. The average percentage represents the proportion of insects to the whole stomach contents, but from 7 to 10 percent of the stomach contents is sand or gravel. Throwing out this mineral element, it appears that on the average 26.17 percent of the Crow's food for the year is made up of insects. In the same way it is found that even in January, when the smallest proportion is eaten, insects form almost 3 percent (2.71) of the food, while the maximum is reached in April with almost 53 percent (52.75). In May, insects constitute about 49 percent (48.97) of the food, and in June about 41½ percent.

During the months of May and June 529 stomachs were collected; insects formed 46.7 percent of all food in these stomachs. Since these two months cover the larger part of the time when Crows are rearing young, this large proportion of insect food perhaps is not surprising, especially as 396 stomachs were those of young Crows taken from the nest. The insect food in the stomachs of these nestlings averaged 49.6 per cent, while the average amount in the stomachs of 120 adult Crows taken during May and June was only 36.4 percent. This shows conclusively that young Crows while in the nest eat more insects than the adults, the difference in this case amounting to more than 13 percent of the entire food; or, to put the matter in another form, nestling Crows eat at least one-third more insects than the adults. It is of great importance, however, that the character of this insect food be carefully determined, so that we may know positively whether its consumption is or is not of benefit to the agriculturist. Fortunately, this has been done. After the preliminary examination of the contents of each stomach and the determination of the percentages of the several kinds of food contained the insect material was referred to Prof. C. V. Riley, then chief of the division of entomology, under whose direction it was thoroughly studied by Mr. E. A. Schwarz. The following reports contain the results of this examination:

REPORT ON THE INSECT FOOD OF THE CROW.

By E. A. SCHWARZ, *Assistant, Division of Entomology.*

The examination of the contents of about 600 stomachs of Crows[1] submitted by Dr. C. Hart Merriam to the division of entomology was intrusted to me by Dr. C. V. Riley, then United States Entomologist. Owing to the large bulk represented by the majority of the stomach contents, and more especially to the comminuted condition of the insect remains, the work of examining and determining was much more tedious and progressed much slower than was anticipated. In the often times difficult determination of minute fragments I have been greatly assisted by the other members of the division of entomology, and more especially by Messrs. William H. Ashmead and Theo. Pergande.

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[1] The insect contents of 801 Crow stomachs were submitted to Professor Riley for examination, but in several cases where many stomachs were collected on the same day and at the same place, under precisely similar circumstances, it was not thought necessary that all should be examined critically. In such cases half or more were thoroughly examined and the results tabulated, while the remainder were passed over with a simple inspection.—W. B. B.

A detailed list of the contents of each stomach has been prepared, enumerating systematically the various species of insects found and giving the number of specimens. This list forms the basis of the following generalizations regarding the food habits of *Corvus americanus*, so far as the insects are concerned:

1. The insect food of Crows is almost exclusively composed of terrestrial species, i. e., such as are found on the surface of the ground, or hide during the daytime at the base of plants or under the various objects lying on the surface; or such as live in the dung of domestic animals, in decaying vegetable and animal matter, or underground.

There is not the slightest indication that Crows catch any insects while on the wing, and the almost complete absence of the numerous arboreal insects of all orders, i. e., such insects as are to be found on, or which live on the trunks, limbs, or leaves of trees and shrubs, indicates that the birds when sitting or resting on trees do not pick up insects.

The almost constant presence of coprophagous insects in the stomachs indicates that Crows preferably frequent dry pasture lands, dry meadows, or very open woods, where cattle or horses are grazing. In many instances the presence of certain species of *Chlænius*, water beetles, or an occasional aquatic Hemipter or a *Gryllotalpa* or *Corydalus*, etc., shows that the birds frequent the margins of ponds or streams, while in a number of other instances the presence of the larvæ of Lachnosterna, Elateridæ, etc., proves that the Crows have followed the plow of the farmer. Many of the terrestrial insects eaten by Crows abound during the warmer season in cultivated fields, more especially in corn and clover fields, and have no doubt been picked up by the birds in such localities.

2. The insect food of the Crow consists only of large or medium-sized insects; small species are only rarely, if ever, picked up. The smallest insects found are certain species of *Aphodius*. Ants form a marked exception to this rule, as small, or very small, species are frequently found in many stomachs.

3. The Crow appears to prefer insects with a hard covering to the more soft-bodied ones. Thus the number of the hard imagos of Carabidæ, Elateridæ, Scarabæidæ, Curculionidæ, and Acridiidæ enormously exceeds that of the Coleopterous, Lepidopterous, and Dipterous larvæ found in the stomachs, and no soft-bodied imagos (a few Diptera excepted) seem to be eaten. In many instances, however, this pecu-

liarity may be explained by the fact that the larvæ, as a rule, live in more hidden situations and are more difficult to find than the imagos. But Crows derive a great deal of their food from the insects living in dung heaps and dead animals where Dipterous and other larvæ abound; still these are but rarely met with in the stomachs. A marked exception to this rule is the frequent occurrence of spiders, and more especially species of the family Lycosidæ, or ground spiders.

4. It would seem that Crows have a predilection for insects possessing a pungent or otherwise strong taste or odor. This is exemplified by the prevalence of Carabidæ (among them the often recurring genus *Chlænius*, possessing a peculiar odor), coprophilous or necrophagous Coleoptera (Silphidæ, Histeridæ, and Scarabæidæ Laparosticti), ants, and more especially by the almost constant occurrence of certain species of the Heteropterous family Pentatomidæ.

5. Finally, as a peculiarity of very little importance, may be mentioned the fact that insects of a bright, and more especially golden, color are apparently very attractive to Crows and are eagerly picked up by them. Thus *Calosoma calidum*, with its bright golden elytral spots, is met with in a large number of stomachs from various localities.[1] Very often only little elytral fragments of this species are found which would seem to indicate that the birds even pick up the elytra of dead beetles. Another striking illustration is furnished by the frequent occurrence of *Euphoria fulgida*, with its peculiar golden-green color. Other examples are the Cicindelidæ, *Pterostichus sayi*, *Geotrypes splendidus*, *Phanæus carnifex*, and others.

If we now proceed to a consideration of the insects eaten by the Crow it is at once evident that a mere list of them, comprising as it does several hundred species, is only bewildering and misleading. If all the numerous species which occur only once or at best in a small number of stomachs and in limited numbers are eliminated, and only those species are taken into consideration which occur in a large number of stomachs and most of which are represented by a very large number of specimens; finally, if we divide the latter class of insects into several convenient groups, each defined by similarity in food habits, we arrive at a certain number of clearly established and characteristic features in the food habits of the American Crow. The writer confidently asserts that, while an examination of several hundred additional stomachs would no doubt greatly increase the list of insects eaten by Crows, it would not alter, in the least, nor materially add to, the characteristic features now arrived at.

It is possible that in the extreme Southern States, as well as in the far West, some other features in the food of the Crow would appear besides those enumerated below; for only a single stomach from Florida and one from Oregon were among those submitted for examination. There were also only a few stomachs from Kansas[1] and Nebraska. Since all the other stomachs were collected at various places in the region extending from Virginia to Maine, and west to Iowa and Wisconsin, we should expect that the difference in the faunal regions would produce a corresponding difference in the food supply of the Crow. But these differences are of slight importance, and with a single exception the main features of the food of this bird remain wonderfully uniform throughout this whole region.

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[1] No traces of our common and bright-colored *Calosoma scrutator* and *C. wilcoxi* have been found in the stomachs, but this is easily explained from the habits of these species which live in the woods and are more or less arboreal, whereas *C. calidum* is strictly terrestrial and frequents pastures and fields.

The following groups of insects representing the principal food supply of the Crow are arranged according to their relative importance, but this sequence might undergo some changes if an equal number of stomachs from all parts of the country were available for examination. Of the stomachs submitted, those from Virginia, the District of Columbia, and Maryland greatly outnumber those from all other localities combined.

1. *Grasshoppers* (Acridiidæ).—During the months of May and June, i. e., during the May-beetle (*Lachnosterna*) season, grasshoppers, mostly of the genus *Tettix*, occur in the vast majority of stomachs, but with few exceptions in moderate numbers only. With the disappearance of the May beetles (toward the end of June) specimens of the typical locusts (grasshoppers—*Melanoplus* and allied genera) increase in number until in the month of August and throughout the fall they constitute by far the greatest part of the insect food, often occurring in astonishing numbers, and often forming the only insect food. Grasshoppers are also largely picked up in winter, evidently on warm days and when there is no snow on the ground.

2. *Dung beetles.*—Under this heading the following Coleoptera are comprised: Species of *Silpha* and *Hister*, the Scarabæid genera *Copris*, *Onthophagus*, *Aphodius*, and allied genera. Certain species of *Staphylinus* are also included here, which, although insectivorous, confine their operations to the droppings of domestic animals. Dung-inhabiting dipterous larvæ or their pupæ were, however, met with in only a few stomachs, and the same may be said of the larvæ of dung beetles. A larger or smaller number of these dung beetles, and more especially of the Scarabæid genera just mentioned, or at least single specimens thereof, occur in most of the stomachs from all localities and throughout the whole year, and in many instances comprise the greater bulk of the insect food.

3. *Ground beetles* (Carabidæ).—These occur likewise in the vast majority of stomachs from all localities and throughout the year, and the list of the species thus found is a very extended one. The genera most frequently present are: *Calosoma*, *Carabus*, *Chlænius*, *Pterostichus*, *Harpa-*

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[1] Since this was written 21 additional stomachs from Kansas have been examined by Mr. Schwarz, but without essentially modifying his conclusions.—W. B. B.

lus, and *Anisodactylus*. It will be noted, however, that none of the species are ever represented by any considerable number of specimens in a single stomach. Thus the bulk represented by the Carabidæ is much inferior to that of the grasshoppers and May beetles, and probably also smaller than that of the dung beetles. Carabidous larvæ were found only in two or three isolated instances.

4. *May beetles* (*Lachnosterna*).—During a short period of the year, commencing, in the latitude of Washington, D. C., at the end of April, and in Maine and Michigan about a fortnight later, and extending toward the end of June, these beetles furnish, as regards bulk, number of specimens, and frequency of occurrence, the principal insect food of the Crow. In fact, there are only a few stomachs during this season that do not contain traces of Lachnosternas, while frequently large numbers of specimens are found in a single stomach, and this often to the exclusion of other insect food. This habit prevails throughout the whole region[1] and would occupy the foremost rank in this enumeration but for the fact that it is restricted to two months of the year.

The fact that the Lachnosterna season coincides with the breeding period of the Crow deserves to be emphasized, and the principal, but by no means exclusive, insect food of the nestlings may thus be said to consist of these Lachnosternas.

Lachnosternas are above ground only at night, when they feed on the foliage of trees and shrubs; they hide during the day underground. In determining the economic status of the Crow as an insectivorous bird it would seem to be of some importance to ascertain how and where the birds find these beetles. It may be that only those are eaten which during their nocturnal flight had been half eaten by bats and other nocturnal enemies of Lachnosterna or which had been otherwise disabled; or it may be that only those specimens are eaten which have fallen into lakes or streams during the night and which are then washed ashore in a drowned or half-drowned condition; finally it may be that the Crows are able to discover and to dig out the beetles during the day from their subterranean retreats. No direct observations on these points seem to have been made, but I have no hesitation in accepting the latter alternative, for the reason that it is an undeniable fact that the Crows find an enormous number of other insects that hide during the day under sticks, clods of earth, and other objects (e. g., many of the Carabidæ), or in the ground at the base of plants (e.g., the Curculionidæ presently to be mentioned). Many of the coprophagous insects, and more especially the genera *Copris* and *Geotrypes*, are evidently dug out from their holes beneath cattle and horse dung. This, of course, does not entirely exclude the other alternatives, and, in fact, the often recurring presence of small ants in the stomachs seems to indicate that the Crows also pick up dead or wounded Lachnosternas which are frequently covered with ants.

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[1] Even the single stomach from Kansas, collected in May (No. 15249), contains nothing except a number of Lachnosternas.

Larvæ of Lachnosterna (white grubs) were, contrary to expectation, met with in a comparatively small number of stomachs (about 20 in all, including a few where determination is doubtful), all of which were collected in the District of Columbia and adjacent parts of Maryland during the months of April and May. If a larger number of stomachs from other localities could have been examined it is possible that white grubs would play a more important rôle in the food habits of the Crow. The absence of Lachnosterna larvæ in all stomachs collected during the fall plowing season is easily explained by the great abundance of grasshoppers at this season. The few Scarabæid larvæ found in stomachs collected in the fall all belong to coprophagous species.

5. *Ground spiders* (Lycosidæ).—The only soft-bodied insects that occur in a very large number of stomachs from all localities and throughout the warmer seasons are various species of Lycosid spiders, which are so commonly met with on the ground in pastures and near water. The larger female specimens, carrying their egg sacs, appear more especially to form an attractive morsel to the Crows. The spiders are often represented in considerable numbers in the stomachs, occasionally forming the greater bulk of the insect food. Spiders of other families were but rarely met with in the stomachs, and never in large numbers.

6. *Weevils* (Rhynchophora).—Two species of weevils, *Epicærus imbricatus* and *Phytonomus punctatus*, both often referred to in economic entomology, occur abundantly in a large number of stomachs. They would play a very prominent rôle in the food supply of the Crow but for the fact that this habit is locally restricted on account of the distribution of the two species. *Epicærus imbricatus* does not extend into the Northern and Northwestern States, and the clover weevil (*Phytonomus punctatus*) is a comparatively recent importation from Europe, occurring from New York to Virginia and gradually spreading into the Northwestern States.[1] Both species are terrestrial during the day and hide in the ground at the base of plants. Other weevils possessing similar habits are not infrequently found in the stomachs, more especially various species of *Sphenophorus* (bill bugs, of economic importance), and in less numbers *Tanymecus confertus*, species of *Sitones*, *Macrops*, etc. Various other nonterrestrial weevils occur only occasionally, the most abundant among them being *Lixus concavus*.

7. *Cutworms* (larvæ of Noctuidæ).—Considering the enormous number of cutworms that occur, especially in the spring and the earlier part of summer, in pastures, dry meadows, and open fields, and considering further that cutworms hide during the day at the base of plants, under leaves, sticks, clods of soil, etc., in short, in just such places as are preferably investigated by Crows in search of food, it is remarkable that

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[1] It was never noted in Michigan prior to 1892, and it is interesting to find that there is a specimen in one of the stomachs (No. 15884) from that State, collected on May 8, 1892.

they do not constitute the largest portion of the insect food. Even if we include all other lepidopterous larvæ and pupæ found in the stomachs, this food does not by any means rank among the most prominent features. The only explanation of this fact that occurs to me has been mentioned before, viz, that the Crows greatly prefer insects with hard bodies. Still, the bulk represented by the Lepidopterous food is by no means an inconsiderable one, and the largest part is made up of Noctuid larvæ, or cutworms. These occur in many stomachs, usually singly or in very small numbers, rarely forming the bulk of the food in any one stomach and never the entire food. Noctuid pupæ were found only in isolated cases. Larvæ of the Pyralid genus *Crambus*, which live in silken tubes at the base of grasses, clover, etc., belong to the family next best represented in number of specimens, and occur in large numbers in a few stomachs. Bombycid larvæ, and especially Bombycid cocoons, come next, represented usually by single specimens. The rest of the Lepidopterous families are represented only by isolated specimens. Single imagos of Lepidoptera were found in only a few instances, and most of these are evidently specimens which had not yet issued from the chrysalis.

8. *Soldier bugs* (Pentatomidæ).—Although by no means representing a considerable portion of the insect food, the constantly recurring presence of various species of soldier bugs constitutes a characteristic feature in the food habits of the Crow. There are many species representing various families of true bugs (Heteroptera) that occur commonly on or near the ground, but, with the exception of these soldier bugs, only a few isolated specimens of a few species were found in all the stomachs. It seems probable that the strong odor or taste of these soldier bugs is the reason why they are so eagerly sought by Crows. The condition in which the specimens are found in the stomachs is also peculiar; for while the Crows generally have the habit of crushing and breaking into fragments all the hard insects they eat, these soldier bugs are almost always broken up in extremely minute particles which in the well-filled stomachs are often liable to be overlooked. Owing to this condition the exact determination of the species, as well as the determination of the number of specimens, is impossible in most cases. The soldier bugs thus found belong to *Podisus*, *Euschistus*, and allied genera.

9. *Ants* (Formicidæ).—As in the case of the soldier bugs, ants form only a small proportion of the bulk of the insect food, but their frequent occurrence in the stomachs suggests the explanation that they are relished by the Crows on account of their peculiar acid taste. Quite a number of species of various genera are represented, the largest species, *Camponotus pennsylvanicus* and various species of *Formica*, being most frequent. The presence of very small species of ants is, in many instances, probably due to accident, as has been mentioned on page 61.

The following enumeration of insects, arranged according to orders, comprises those which occurred only in a moderately large number of stomachs and usually only as single specimens, or only in a few stomachs in large numbers. Some of the insects of this class have already been mentioned.

Click beetles (Elateridæ).—A tolerably large number of species were found, but none of them represented by any considerable number of specimens. The most abundant of these species are *Limonius plebejus, Corymbites cylindriformis, Agriotes mancus.* Elaterid larvæ (wireworms) were found only in a few isolated instances.

Lamellicorn beetles.—Lucanid beetles (*Lucanus, Passalus*) occur occasionally, while various species of the Scarabæid genera, *Serica, Hoplia, Anomala, Aphonus, Euphoria*, and others, form in the aggregate a not inconspicuous portion of the insect food. The prevalence of *Euphoria fulgida*, or at least of little fragments thereof, in quite a number of stomachs has been already alluded to.

Tenebrionidæ.—Some specimens of the genus *Eleodes,* found in the few stomachs from Nebraska and Kansas, lead to the supposition that if a larger number of stomachs from that region could be examined specimens of this and allied genera would be found well represented. These beetles, so characteristic to the fauna of the arid region of the West, fulfill most of the requirements of insect food preferred by the Crows; they are terrestrial, large, hard, and possess a strong, offensive odor.

Ants, Bees, and Wasps (Hymenoptera).—Besides Formicids only a very moderate number of species and specimens were found, most of them belonging to the fossorial families Crabonidæ and Eumenidæ (genus *Odynerus*). Quite a number of *Polistes* also occur in various stomachs.

Flies (Diptera).—The whole order is comparatively poorly represented, and only the following families deserve mention:

Crane flies (Tipulidæ).—These are much less frequently found than one would expect from their great abundance on meadow land. Still, eggs, larvæ, and much more rarely pupæ and imagos occurred in a moderate number of stomachs. In a few instances eggs were found without any trace of the imago.

March flies (Bibionidæ).—Larvæ of this family were found only in a few stomachs, but in very large numbers. They live gregariously under decaying vegetable substances.

Muscidæ.—The small number of the various larvæ and puparia, all presumably belonging to coprophagous or necrophagous species, found in the stomachs is in striking contrast with their enormous abundance in the excrement of horses, cattle, etc., or in dead animals. Imagos of these Diptera were found only in exceptional instances.

Crickets (Gryllidæ).—Excepting the Acridiidæ, the whole order of Orthoptera is very poorly represented; the only other representatives which occur in a moderate number of stomachs are ground crickets of the genera *Gryllus* and *Nemobius.*

The orders hitherto omitted, viz, the Homoptera and Neuroptera (in the old sense), are so poorly represented as to deserve no special mention. The same may be said of the order Myriapoda, of which a few specimens of a *Julus* were found.

In order to complete this picture of the food habits of the Crow, it is important to mention briefly those families, or even single species, of insects which are of economic importance, being either injurious or beneficial, but which were not found in the stomachs examined. Only such insects are mentioned here as occur on or near the ground and of which one might expect that the Crows, at least occasionally, would pick up specimens. Some of the orders or families unrepresented, or but poorly represented, have been mentioned before and are not here repeated.

Among the Coleoptera the absence of the useful ladybirds (Coccinellidæ) deserves special mention (only a single elytron of one species has been found). Still more striking is the absence of the large family of leaf beetles (Chrysomelidæ), including the notorious Colorado potato beetle (*Doryphora 10-lineata*). In fact, only four species of Chrysomelidæ were found in all the stomachs (two elytra of *Paria canella*, one elytron of *Colaspis brunnea*, and a few specimens of the aquatic *Donacia flavipes*). Chrysomelid larvæ are entirely absent. Finally, the soldier beetles of the genera *Chauliognathus* and *Telephorus* in the family Lampyridæ are not represented, and only two larvæ of a *Telephorus* were found in a single stomach.

In the Hymenoptera no injurious (phytophagic) families are represented, but, on the other hand, the immense host of beneficial (parasitic) species is also almost entirely absent, only a few isolated specimens having been found. The Crow is not one of the destroyers of the honeybee, for only a single bee occurred in all the stomachs.

In the Lepidoptera, which practically do not contain any beneficial species, the absence of all cabbage worms (larvæ of *Pieris rapæ*, *Plusia brassicæ*, etc.), excepting a solitary specimen, deserves mention; also the absence of the various Sphingid larvæ and their pupæ, which infest potatoes, sweet potatoes, and tobacco. The corn worm (larva of *Heliothis armigera*) is here especially mentioned because it is said that the Crows pull out and injure the ears of corn only for the purpose of getting at the corn worms. This species has not been recognized, but it is possible that a few specimens are among the unidentifiable Noctuid larvæ.

In the Diptera the most injurious species is the Hessian fly (*Cecidomyia destructor*), but the small size of the larva and pupa, as well as their mode of occurrence, make it improbable that the Crows ever feed upon this insect, and no traces of them were found in the stomachs. The beneficial Diptera, viz, larvæ of Syrphidæ and the family Tachinidæ, are absent.

The complete, or almost complete, absence of the injurious Heteroptera forms a very striking feature. In all the stomachs examined only a single specimen of the notorious chinch bug (*Blissus leucopterus*) was found, and, unless we assume that this insect is too small, no explanation is offered why the Crow does not feed extensively upon the chinch bug, which possesses a strong odor and is more or less terrestrial in its habits. Excepting the Soldier bugs (Pentatomidæ), the insectivorous species of Heteroptera are hardly represented; the Phymatidæ are entirely absent (no doubt on account of their nonterrestrial mode of life), and of the Reduviidæ only a few specimens of a terrestrial species were found.

In the Homoptera the stomachs submitted for examination offered no opportunity for ascertaining whether or not the Crow feeds extensively upon the periodical cicada, but from the fact that in a small number of stomachs pupæ and imagos of another species of cicada were found, as well as from previous records and observations, there can be no doubt that this insect is not refused. The more or less injurious leaf hoppers (families Jassidæ, Cercopidæ, Fulgoridæ, Membracidæ), many species of which are frequently found on or at least near the ground, are not represented in the stomachs (excepting a single larva of a Fulgorid).

The only beneficial (insectivorous) family among the Orthoptera, viz, the Mantidæ, is represented in our fauna by only a few species, and none have been found in the stomachs.

No specimens of white ants (Termitidæ), the only injurious family of the old order Neuroptera, occurred in the stomachs, while of the eminently beneficial families only a single specimen of a mosquito hawk (Æschnidæ) and a single specimen of a lacewing fly (Hemerobidæ) were found.

All the families of spiders are insectivorous, but only a few are really useful to man, e. g., the Thomisidæ and the orb-weavers (Orbitelariæ). These are almost entirely absent, and the only family which is well represented (the Lycosidæ) has no economic importance.

No ticks (Ixodidæ) were found in the stomachs.

The insectivorous myriapods are not represented, being probably protected by their mode of life.

It will be seen from the foregoing remarks that among the principal insect food of the Crow there are only two classes of eminently beneficial insects, viz, the ground beetles (Carabidæ) and the soldier bugs (predaceous Pentatomidæ). The ground spiders (Lycosidæ) and the ants are, in the opinion of the writer, to be classed among the neutral or innoxious insects, which class also includes the dung insects, many of the lamellicorn beetles, and a great many of the other insects found in smaller numbers in the stomachs. All the rest belong to the injurious insects, notably the grasshoppers, May beetles (including some allied genera), the click beetles (Elateridæ), the weevils (Rhynchophorous Coleoptera), the cutworms (in fact all Lepidoptera), and the crane flies (Tipulidæ).

It is evident that the percentage of the three groups of insects forming the chief insect food of the Crow can not be determined from the number of species nor from the bulk represented by the aggregate of each species, but must be determined by the number of specimens. It is difficult to give exact figures on this last point for two reasons, viz:

1. While it is easy to determine the number of specimens of a given species where there are but few in the stomach, it is often impossible to do so where the number is great and the specimens are in the decomposed condition in which insects are usually found when in such numbers. In most instances the number could only be approximated by the number of heads or mandibles, as the remainder of the body has been essentially destroyed by digestion.

2. A large proportion of the stomachs submitted are those of nestlings, and it follows that the mere fragment of any given insect is counted in such a case as a specimen, while it is probable that a single specimen may have been given in fragments or portions by the parent to several of the nestlings, so that combined they represent but one single individual. Nevertheless the difficulties do not, in my judgment, invalidate the general conclusions arrived at, which are, that the sum total of specimens of those insects which are emphatically injurious to agriculture vastly outnumbers those which may be considered beneficial, and that it also surpasses the number of beneficial and innoxious species combined.

The facts on the whole overwhelmingly speak in favor of the Crow, and taken alone would be at variance with the prevalent opinion hitherto held and yet held regarding the economic status of the Crow as an insectivorous bird.

How far these general conclusions may be modified by the indirect nature of the food examined, i. e., by the habit of the Crow of feeding upon toads and frogs and even small birds and other insectivorous animals, I am in no position to determine. It is probable, however, that only a small proportion of the insect food of the Crow is derived in this indirect manner and that in so far the conclusions as to its economic status are not to be modified.

A complete list of the insects contained in each one of the six hundred or more stomachs critically examined would not only make the present bulletin too bulky, but the constant repetition of names would only mislead and bewilder the reader, if indeed any enthusiast would care to read it all. It is better, therefore, to omit the detailed statement of the insect remains found in each stomach and give only the general results.

TESTIMONY FROM CORRESPONDENTS RESPECTING THE INSECT FOOD OF THE CROW.

During the past ten years the division of ornithology has received statements from more than a thousand observers respecting the food habits of the Crow. So far as the insect food is concerned, most of these statements are of little value, because from the nature of the case it was impossible to tell what species of insects were eaten. Aside from such sweeping and groundless assertions as 'Crows eat no insects at all,' and 'Crows eat insects of all kinds,' scores of statements were received which were obviously incorrect, although evidently made with perfect sincerity. On the other hand, it is of interest to note how fully many of the more explicit statements are confirmed by the examination of stomachs. For example, the habit of catching grasshoppers was observed and reported by many correspondents, and the same is true of the May beetle or June beetle (*Lachnosterna*) and its larva, the white grub. The Crow's habit of following the plow was noticed more than a hundred years ago, and the principal error made by many of our correspondents lies in the assumption that the bird devours indiscriminately all the different insects thus exposed. Among the most common mistakes may be mentioned the case of the Colorado potato beetle (*Doryphora 10-lineata*), upon which the Crow was reported to feed by many observers. The fact that not a single trace of this beetle was found in any of the 909 stomachs, 500 of which were collected at times and places favoring its capture, must be taken as proof positive that the Crow rarely, if ever, touches this pest. The further fact that only four species (each represented by one or two individuals) belonging to the same family as the potato beetle (Chrysomelidæ) were found in the stomachs shows clearly that insects of this kind are thoroughly disliked by the Crow.

Following are a few examples of the voluminous testimony received from correspondents:

CALIFORNIA, *San Bernardino.*—F. Stephens: The Crow is in the habit of following the plow, picking up cutworms, white grubs, larvæ, etc., sometimes in large quantities. 1885.

CANADA, ONTARIO, *London.*—W. E. Saunders: Last summer (1885) I watched a flock of probably 2,000 crows catching grasshoppers.

CONNECTICUT, *East Hartford.*—Willard E. Treat: Worms and grasshoppers are destroyed by Crows; they eat large quantities of grasshoppers and the large white grub usually found in cornfields, especially in August. 1885.

South Woodstock.—Mrs. G. L. F. Stoddard: The Crow has been observed to feed upon cutworms and grubs that live just beneath the surface and are more readily exposed by the pulling up of the corn, which the cutworms and grubs would destroy. 1886.

INDIANA, *Brookville.*—A. W. Butler: The Crow feeds on the seventeen-year cicada. 1885.

Medora—Charles Eshorn, jr.: I have noticed them every season walking over a meadow just after the hay has been cut, catching grasshoppers, but I have never noticed them hunting insects in a meadow after the grass was 2 or 3 inches high, and of course from that time until it is cut is the time that insects damage it most. 1892.

Nebraska.—J. D. Kuster: Crows have fed extensively on locusts this year. 1885.

IOWA, *Wapello.*—D. C. Beaman: It will feed on all kinds of grubs and worms which are thrown out by the plow. 1886.

LOUISIANA, *Abbeville.*—W. W. Edwards: I nave not observed them eating any insects except the larvæ and grubs, on which they feed extensively in the spring on fresh-plowed ground. I am not able to say what larvæ they feed on. 1886.

Bayou Goula.—W. C. Percy: It has been observed to eat locusts, but I have never been able to find any other insect in its stomach except grubs, etc. 1885.

MAINE, *North Livermore.*—George H. Berry: The Crow eats grasshoppers, potato bugs, and *Clisiocampa* larvæ. 1886.

MASSACHUSETTS, *Amherst.*—Hubert L. Clark: I believe that the Crow is largely insectivorous. It frequents marshes and open fields in search of food in large flocks, where it destroys large quantities of grubs, particularly those of the common June bug (*Lachnosterna fusca*), grasshoppers, and locusts. It also destroys cutworms. 1885.

East Templeton.—Charles E. Ingalls: I have seen the Crow eat grasshoppers and have also seen it feed on a large white grub taken from the ground in old fields. 1885.

MICHIGAN, *Hudson.*—A. H. Boies: I have often observed it seeking for grubs and other larvæ in the spring, and know that it is a great destroyer of such when other forage is scarce. 1885.

Lickleys Corners.—A. H. Carver: I have known them to follow the plow in the spring and pick up cutworms and the large white grub. 1886.

Thornville.—John S. Caulkins: The following statement relative to Crows eating cutworms was given me by a friend, William B. Sutton, of Lapeer. He said he had plowed and dragged a piece of old sod and noticed that a flock of Crows were frequenting it. Sharing to some extent the hostility the farmers generally feel toward the Crows on account of the damage they do to corn, he concealed himself with his loaded shotgun in a corner of the fence, close to where the Crows worked, thinking to shoot a few and hang them up as a terror to the rest. When the crows came he distinctly saw them turn over the sods, shake them to pieces, and eat the cutworms that fell out. He came away without shooting, and since then has been the professed friend of the Crow. 1886.

NEBRASKA, *London.*—George A. Coleman: In May and June we find him following the plow, seeking earthworms, insects, and mice. His favorite food is the larva of the June bug (*Lachnosterna fusca*), which he finds in great abundance. 1888.

NEW HAMPSHIRE, *Webster.*—Charles F. Goodhue: At this season Crows are of some benefit to the farmer, as they feed mostly on grasshoppers. To-day (August 22, 1885), a flock of nearly 100 were observed in a pasture badly infested with grasshoppers, upon which they were evidently feeding.

NEW JERSEY, *Merchantville.*—Edward Burrough: The Crow ought not to be condemned for it is one of our best insectivorous birds. It eats the June bug and the larvæ of any insect plowed up in the spring, such as white grubs and cutworms. 1886.

NEW YORK, *Alfred Center.*—F. S. Place: Crows destroy insects. Several specimens taken by me last spring (1886) had their stomachs filled with insects, mostly Coleoptera.

Boonville.—Morris M. Green: Near Boonville I have seen the Crow feeding on grasshoppers during the summer months. Some fields seemed to be fairly black with the birds pursuing the grasshoppers in every direction. One day, noticing a flock of Crows frequenting a particular field, I visited the place and found that the roots of the grass had been completely eaten away, so that the sod or turf could be rolled up like a rug or carpet. A farmer living in the vicinity told me that the Crows visited the place every day to feed upon the grubs that destroyed the turf. The grubs or larvæ were about three-fourths of an inch in length; body whitish, with some dull plumbeous underneath; head blackish. I think these are the kind so often found in corn hills and which do much damage to the corn. If so, this speaks a good word for the Crow. 1887.

Waverly.—S. J. Wolcott: Crows in the springtime feed largely on cutworms, both on sod lands and after the same have been plowed. I have known them to work on cutworms in my tobacco field. After setting, when the worms are cutting the young plants, the Crows are there every morning. and no doubt destroy great numbers of them. They have been reported to eat potato bugs to some extent, but I am not prepared to verify the statement. 1892.

North Carolina, *Pittsboro.*—E. T. Adney: It eats a great many insects, particularly grasshoppers. 1885.

Ohio, *Wakeman.*—W. B. Hall: Crows are decidedly insectivorous if domestication does not alter their habits. At different times I have kept Crows which were taken from the nest when nearly full fledged. They became very tame, so that I had a chance to watch their actions and manner of feeding. I find that they are not particular in their diet as to whether the insect is injurious or beneficial. They feed greedily on the different species of cutworm (*Agrotis*) and on the white grub (larva of *Lachnosterna fusca*). When plowing they will follow in the furrow and pick up every grub or beetle in sight, and when their appetites are satisfied they fill their beaks with insects and hide them under sticks, leaves, or stones. I have often taken the pains to look up their hiding places and count the insects thus hidden, and I have been astonished at their numbers. They kill predaceous beetles, but do not often eat them, I think on account of the peculiar odor most of them emit. For the sake of experiment, I have taken the Crows to a board or stone which, on being removed, exposed many black beetles (mostly *Galerita*). They would pounce on a beetle, give it a pinch through the head or thorax, drop it, and seize another with such rapidity that but few, if any, escaped. I could not on any condition tempt their appetites with Colorado beetles, squash bugs, cucumber bugs, or any of the soldier bugs or ladybirds (*Coccinella*). I had a male Crow that would eat the cabbage caterpillar (*Pieris rapæ*) with evident relish, while his mate disdained such plebeian diet. They would kill the sow bugs (*Oniscus*) and species of Myriapoda, but would not eat them.

Wauseon.—Thomas Mikesell: It feeds on cutworms, May beetles, white grubs, chinch bugs, and eggs of grasshoppers. These form its principal food. 1885.

Waverly.—H. W. Overman: It is a lover of grasshoppers and destroys great numbers of them, especially in the fall. 1885.

Oregon, *Dilley.*—George S. Johns: It feeds extensively on grasshoppers and crickets. 1885.

Pennsylvania, *East Brook.*—T. Scott Fisher: I watched a pair of Crows follow me day after day last spring (1886) while plowing sod, and have seen one Crow pick up 25 to 40 white grubs, cutworms, and wireworms at one time, and then fly to the woods for an hour or so, then back again.

Philadelphia.—J. Percy Moore: When the seventeen-year cicada appeared this summer (1885) the Crow fed extensively on both its pupæ and imagos. The young were fed, to some extent, on the pupæ (May 30, 1885). As they had not at this time appeared above the ground, I suppose the Crows obtained them in plowed fields. On June 17 I noticed them feeding on the adults. I have seen Crows feeding in plowed fields before the grain was planted (March 10, 1885), and I think they were feeding on the larvæ of the June bug or other beetles which live in the ground. I have also seen them eat large ants which live on trees and burrow into the wood (July 1) and other species of insects which I was not able to identify from a distance.

VERMONT, *Hydeville.*—A. I. Johnson: Crows catch countless numbers of crickets and grasshoppers after the hay is cut. They can be seen almost any time of day on the meadows catching grasshoppers. I observed one pair of old Crows this summer, when I was haying, that were feeding their young almost entirely on grasshoppers; the old Crows would alight on the mown land within 8 or 10 rods of me, and after catching a hopper or two would fly to their young that were on a fence and there feed them. Of all our birds, the Crow, I think, is the most extensive feeder on grasshoppers. 1885.

West Pawlet.—Frank H. Braymer: It has been observed to feed to a certain extent on the cankerworm, cutworm, various kinds of grasshoppers, and small beetles. Probably the benefit derived from the destruction of insects is considerable. 1885.

VIRGINIA, *Birdsnest.*—C. R. Moore: Crows follow the plow in the spring and eat many cutworms, and probably other insects, but I only know positively of cutworms. 1886.

Drewrys Bluff.—A. R. Bellwood: During at least ten months of the year in this part of the country large numbers congregate on the pasture fields, meadows, and plowed land, and remain for hours searching for larvæ and insects. 1891.

Fork Union.—J. B. Underhill: As to the insect diet of the adult I can not testify, having never examined the gizzards. The gizzards of two young which were taken from the nest were filled to overflowing with grasshoppers, and each contained one or two kernels of corn. 1886.

Lick Run.—J. G. Paxton: The Crow has been destroyed by poisoning until it is now nearly exterminated, and there is a noticeable increase of insects of every kind. It eats insects more or less, except the Colorado potato beetle. 1885.

WISCONSIN, *Clinton.*—C. N. Crotensburg: I have never known the Crow to refuse any insect except bees, of which it is exceedingly shy.

CHAPTER IV.

VEGETABLE FOOD OF THE CROW.

As already shown, the vegetable food of the Crow amounts to about 57 per cent of the whole food. Of this, corn is of the greatest importance to the farmer, since its destruction is one of the most serious charges made against this bird. But in addition to corn the Crow feeds on several other kinds of grain and also on mast and many fruits and seeds.

The following table shows the various vegetable substances found in Crows' stomachs and the percentage of each to the whole vegetable food for each month:

Table showing the kinds of vegetable food found in Crows' stomachs and the percentage of each, arranged by months.

Month.	Number of stomachs examined, 909.	Corn.	Wheat.	Oats.	Barley.	Unidentified grain.	Buckwheat.	Wild rice (*Zizania*).	Grass and weed seed.[1]	Unidentified seeds and fragments.	Acorns.	Chestnuts.	Beechnuts.	Palmetto and pecan nuts.	Cherries.	Wild cherries.	Strawberries.	Blackberries and raspberries.	Mulberries.
January	53	28.5	2	1.9	....	....	....	0.9	2.1	2.1	4.7	....	....	1.1	....	....	....	....	....
February	23	39.4	1.7	2.9	....	....	....	4.2	....	....	9	....	....	....	....	....	....	....	....
March	26	15	1	7.9	....	1.8	5.1	6.5	1.7	T[2]	9.4	....	2.9	2.7	....	....	....	....	....
April	42	15.6	.6	2.4	....	....	1.6	T	T	.4	.7	....	....	....	....	....	....	....	....
May	364	17.7	.5	.4	....	.9	.2	T	T	T	.8	T	.4	....	0.2	....	T	T	....
June	165	14.3	.6	2.2	1	3.6	1.4	T	T	.2	.6	....	T	....	10.5	....	1	.5	1.3
July	45	8.4	8.3	2.7	....	2.6	....	...	.6	.2	3.2	....	....	....	10.2	2	3	4.6	.1
August	24	11.4	9.5	3.8	....	2.2	....	....	....	....	....	....	....	....	....	6.6	....	2.3	....
September	44	24	2.4	.9	....	1.6	.7	T	T	....	3.2	T	....	....	....	3.3	....	.1	....
October	46	18	2.8	.1	....	1.9	....	....	.1	....	15.6	2.2	.4	.3	....	.2	....	....	....
November	18	17.8	1.4	3	....	1.1	....	....	.1	....	9.7	1.3	....	....	....	....	....	....	....
December	59	48.2	.7	1.1	....	.5	....	.4	.4	.3	3.9	.9	1.1	....	....	....	....	....	....
Percentage of total food of year	....	21.5	2.8	2.4	T	1.4	.8	1	.4	.3	5.1	.4	.4	.3	1.7	1	.3	.6	.1

Month.	Elderberry (*Sambucus*).	Blueberries and huckleberries.	Juneberry (*Amelanchier*).	Bull berries (*Shepherdia*).	Pokeberry (*Phytolacca*).	Grapes.	*Ampelopsis*.	*Viburnum*.	Cornels.	Sour gum (*Nyssa*).	Holly, cat brier, Barberry, cedar.
January	......	......	......	......	......	......	......	......	......	......	trace.
February	......	......	......	......	......	......	......	......	......	......	0.5
March	......	......	......	......	......	......	......	......	......	......	......
April	......	......	......	......	......	......	......	......	0.9	......	trace.
May	......	......	......	......	......	......	......	......	trace.	......	......
June	0.3	......	0.4	......	......	......	......	......	......	......	trace.
July	.2	2.3	.3	......	......	......	......	......	......	......	......
August	1.2	1.8	......	......	0.2	9.7	......	......	1.7	......	......
September	......	......	......	3.9	.3	13.9	trace.	......	2.6	1	.1
October	......	......	......	......	.3	5.1	0.7	0.4	1.9	......	trace.
November	......	......	......	......	......	.3	1.1	......	2.5	.2	......
December	......	......	......	......	......	.1	......	......	.5	......	1
Average	.1	.3	.6	.3	trace.	2.4	.2	trace.	.8	.1	.1

[1] The seeds included here are: *Amarantus*, *Ambrosia*, *Trifolium* (clover), *Malva*, *Polygonum*, *Rumex*, *Setaria*, and grass seed unidentified.

[2] T = trace.

Table showing the kinds of vegetable food found in Crows' stomachs and the percentage of each, arranged by months—Continued.

Month.	Bayberry (*Myrica*).	Nonpoisonous sumac.	Poison *Rhus*.	Apple pulp and seeds.	Cucurbitaceous seeds or pulp.	Fruit not identified.	Potato pulp.	Tubers or roots undetermined.	Mushrooms.	Rubbish.
January	......	6.6	3.9	0.2	1.6	0.3	.....	....	......	4.9
February	......	10	.6	......	1.7	....	.....	....	......	.7
March	......	.9	......	1.2	.3	....	.....	2.6	......	7.2
April	0.5	.7	......	.1	....	2.5	.....	....	......	5.2
May	......	trace.	......	......	trace.	.3	.....	trace.	......	6.4
June	......	trace.	trace.	......	.7	.8	0.9	....	......	4.8
July	......	......	......	......	1.1	.1	1.1	....	0.7	4
August	.7	......	.5	3.8	....	.5	.....	....	......	1.5
September	.9	......	3.4	.4	....	.3	.....	....	......	1.7
October	1.6	......	8.5	......	.2	.6	.....	....	......	3.5
November	4.3	4	6	.9	....	....	.....	....	......	2.4
December	......	5.1	4	......	trace.	....	.....	.5	......	5
Average	.7	2.3	2.2	.6	.5	.5	.2	.3	.1	3.9

CORN.

Corn is an important crop in nearly every State and Territory of the Union, and in many States the area devoted to it exceeds the combined areas of all other cereals. The crop of 1892, though below the average of recent years, amounted to 1,628,464,000 bushels, and the area planted was 70,626,658 acres. Throughout most of the region from which Crow stomachs were obtained the acreage of corn was far in excess of the general average for the United States. In Maryland, for example, in 1892 one-tenth of the entire land area was planted in corn. In Ohio the acreage was somewhat greater proportionally, and in Iowa, the greatest corn State in the country, about one-fifth of the entire area of the State was given to corn. In other years these figures have been exceeded. It is evident, therefore, that except under the most unusual circumstances corn must be readily accessible to Crows in all parts of the country from the time of planting until harvested and housed.

In many places cornfields are more or less protected from the attacks of Crows during the time of planting and until the corn is too large to pull, but most attempts at protection are only partially successful, and as a rule such efforts are confined to newly planted fields, no attempt being made to keep Crows away from corn in the milk, or at any later stage. Under these circumstances, if Crows were extraordinarily fond of corn it might be expected to form a very large part of their food during that portion of the year when it is most accessible.

The general impression that the Crow likes corn under all circumstances is a mistake. Crows certainly eat considerable quantities of corn during every month in the year, but, as shown further on, they are not fond of ripened corn, and only eat it when more desirable food is scarce. It must be remembered that for several months in the winter the Crow's life is an almost continuous struggle for existence, and there are times almost every winter when the customary sources of food supply are temporarily cut off by deep snow or excessive cold, or become entirely exhausted, compelling the Crow to resort to any shift which will keep him alive. Moreover, the evidence accumulated in the past few years shows clearly that the Crow is primarily a carnivorous bird. A small proportion of vegetable food is doubtless eaten with relish at all seasons, but the larger part is probably taken from necessity and not from choice, and it seems certain that a very large part of the corn eaten in cold weather is taken for the same reason. A caged Crow which was kept for several months in the winter of 1889 and 1890 invariably refused hard corn, either whole, cracked, or ground, so long as animal food of any kind was to be had, and it was only after many hours of absolute fasting that he turned voluntarily to grain of any kind. The Crow is fond of sprouting corn, and delights to pull up the young shoots as they come through the ground. When corn is in the milk, and the kernels are well filled out but still soft, the Crow seems very fond of it, and sometimes does considerable damage before the grain hardens. But after the kernel becomes fairly hard the Crow no longer seems to relish it, and cases of serious damage to ripened corn are extremely rare.

Probably the damage to sprouting corn and corn in the milk is much lessened by the fact that at the seasons when these are obtainable other food of the most attractive kind is superabundant. This is true particularly of the season when corn is in the milk, for during July, August, and September both animal and vegetable food are at their maximum, and except during the early part of July all Crows are self-supporting, the young being large enough by that time to provide for themselves. The damage to sprouting corn is done mainly in May and June, at which time most Crows have young in the nest and are compelled to provide them with food, besides finding food for themselves.

Keeping these facts in mind, the results of the stomach examinations will be perfectly intelligible, and some of the facts brought out acquire special significance.

Nine hundred and nine stomachs which contained food were examined, and 444 of these, or about 49 percent, contained corn, the average amount being about 40 (40.49) percent for the 444 stomachs, or 21.5 percent for the whole number.

The table which follows shows the number of stomachs for each month, the actual and proportional numbers containing corn, and the average quantity of corn for each month.

TABLE I.—*Showing corn in Crow stomachs.*

Month.	Number of stomachs examined.	Number containing corn.	Percentage containing corn.	Average percentage of corn in stomachs containing it.	Percentage of corn to total food of species.
January	53	29	54.7	52	28.5
February	23	16	69.5	56.7	39.4
March	26	11	42.3	35.5	15
April	42	16	38.1	40.9	15.6
May	364	201	55.2	32.1	17.7
June	165	62	37.6	38	14.3
July	45	10	22.2	37.9	8.4
August	24	6	25	45.7	11.4
September	44	20	45.4	52.7	24
October	46	17	36.9	48.6	18
November	18	10	55.5	32	17.8
December	59	46	77.9	61.9	48.2
Total	909	444	* 49	* 40.49	* 21.5

* Average.

Since the food of Crow nestlings differs in several particulars from that of adult Crows, the two following tables have been prepared showing the amounts of corn eaten respectively by adult Crows during the entire year and by Crow nestlings in April, May, June, and July:

TABLE II.—*Showing corn in stomachs of adult Crows.*

Month.	Number of stomachs examined.	Number containing corn.	Percentage containing corn.	Average percentage of corn in stomachs containing it.	Percentage of corn for all stomachs.
January	53	29	54.7	52	28.5
February	23	16	69.5	56.7	39.4
March	26	11	42.3	35.5	15
April	17	10	58.8	60.1	35.3
May	69	52	73.9	51.6	38.9
June	84	28	33.3	46.4	15.2
July	45	10	19.5	42	8.2
August	24	6	25	45.7	11.4
September	44	20	45.4	52.7	24
October	46	17	36.9	48.6	18
November	18	10	55.5	32	17.8
December	59	46	77.9	61.9	48.2
Total	508	255	* 51	* 51.5	* 25

TABLE III.—*Showing corn in stomachs of nestling Crows.*

Month.	Number of stomachs examined.	Number containing corn.	Percentage containing corn.	Average percentage of corn in stomachs containing it.	Percentage of corn for all stomachs.
April	25	6	24	9	2.2
May	295	149	50.5	25.3	12.8
June	81	34	42	31.1	13.1
Total	401	189	* 47.1	* 25.8	* 9.3

* Average.

It appears from these tables that corn forms about one-fourth (25.9 percent) of the food of adult Crows, and less than one-eighth (12.2 per cent) of the food of Crow nestlings.

The last column of the table, giving the percentage of corn eaten by adult Crows in each month, shows that the quantity is very large during the season of planting and sprouting,—which season, in the region from which most of the stomachs came, covers the latter part of April and part of May.[1] In midsummer (July and August), on the other hand, the percentage falls to the lowest point reached during the year. At this season no sprouting corn is available and the coming crop is too young to be eaten. During July, too, the available waste corn is at its minimum, while animal food is superabundant. Small fruits, both wild and cultivated, also abound at this season, so it is not surprising that the percentage of corn is very low. During August and September there is a marked increase in the amount of corn eaten, and much of it is soft (i.e., in the milk) and a direct loss to the farmer. In October the ratio still increases, but apparently falls away again in November; but the number of stomachs collected during this month is too small to serve as a safe criterion. In October and November chestnuts, beech nuts, and acorns commonly abound and furnish an ample supply of vegetable food. In fall, winter, and early spring the corn eaten is waste grain, and its consumption entails no loss to the farmer.

According to the stomachs examined for May, 38.9 percent of the food of adult Crows and 12.8 percent of the food of nestling Crows during that month consisted of corn. Taking young and old together, the percentage is 17.7. In the case of the nestlings the number of stomachs (nearly 300) is sufficient to give a trustworthy result, but in the case of the adults (only 69) it is too small.[2] Furthermore, nearly all of the adults were collected in localities where corn is the dominant crop and easily obtained. A large proportion was doubtless pulled from the ground soon after coming up and hence was a direct loss to the farmer. But this loss, as shown later, may be prevented by tarring the seed corn.

It is a prevalent belief among farmers that sprouting corn is taken chiefly to feed the young in the nest, and many think that the old Crows would not pull corn at all were it not for their young. The stomach examinations show this belief to be largely, if not entirely, unfounded. Table III shows that the average amount of corn in the stomachs of Crow nestlings is only half as great as in the stomachs of adults taken at the same time. As a matter of fact, young Crows for the first fortnight are rarely fed any corn at all, nearly all the food given them being animal. This is in accord with what is known of other birds that are general feeders, and might have been predicted after the essentially carnivorous habits of the adults were established.

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[1] In April a considerable part of the corn eaten must be waste corn, since in the latitude of Washington, D. C., comparatively little is planted until the latter half of this month. Farther south the planting is earlier, and the young corn is available at a correspondingly earlier date, but very few of the stomachs under consideration were taken south of Maryland.

[2] This is equivalent to 12.9 per cent of the total quantity of corn eaten during the year, or a trifle over 2 per cent of the total food. Hence, admitting that all the corn eaten by adult Crows in May is sprouting corn, which of course is not the case, the loss would amount to only 2 per cent of the food of the Crow. If young and old are taken together the percentage is even less, exactly 1.6 per cent.—C. H. M.

Almost invariably the stomachs of very young Crows were devoid of any trace of corn, while the stomachs which contained large quantities were those of birds at least half grown, and in many cases described by the collectors as 'full fledged,' 'ready to leave nest,' or 'already out of nest.' Young birds of this size are apt to call continually for food, and their parents are compelled to work industriously to keep them alive.

In the case of corn in the milk the quantity destroyed is even less than that of sprouting corn. Allowing a month (middle of August to middle of September) as the average period when corn is in the milk in the region from which most of the stomachs came, it is found that less than 7 percent of the corn, or less than 2 percent of the total food, is corn in the milk.

Testimony from observers respecting the destruction of corn.—The following extracts from correspondents are selected from a large number.

From Charles Eshorn, jr., Medora, Ind., 1892:

> Crows destroy a great deal of corn in this section of the country, both at planting and roasting-ear time. Just after the young corn shoots (or sprouts) are through the ground, the crows pull up a great many grains, often damaging a field so much that it must be replanted. The extent of the damage done in this way is about 5 per cent. But they do most mischief while the corn is in the milk. They tear away the husks from the end, but rarely eat more than two or three dozen grains from each ear, but they tear open as many as a dozen ears in one day. An ordinary flock of 40 or 50 Crows feeding on a field of corn for a week, each Crow damaging 12 ears per day, would do considerable damage—say 5 percent.

From Dr. M. McKenzie, Centerville, Reynolds County, Mo., 1889:

> As to corn, they take it from the time it shows above ground till there is no vestige of grain at its roots, then rest till it begins to silk; then they begin to tear the shuck, and keep at it as long as left in the field, doing more damage by the torn ear taking water and rotting than what they eat, although they eat lots. I had to replant three times, and then did not get a stand.

From A. R. Bellwood, Drewrys Bluff, Va., 1891:

> In the spring they settle in large flocks on the newly sown fields and eat the grain that has not been covered. They commit the greatest havoc in the cornfields, beginning to pull it out as soon as any of the corn is up, and continuing until it is 3 or 4 inches high. When the sprout breaks off they rapidly dig the earth from over the grain and secure it even though it be quite deep. In this manner a small number of Crows do a great amount of damage. * * * In the fall, before the corn has become hard, large flocks often alight on the largest ears and tear the husks from the upper side near the end. They not only devour the corn, but leave the ear so exposed that the rain gets under the husk and rots a large portion of what they do not eat. Some farmers have told me that they only interfere with the ears that contain worms, but I know with certainty that such is not the case.

WHEAT.

Wheat occurred in 43 stomachs out of the 909 examined. The average quantity in the 43 stomachs was 32 percent, although the average for the year was only 2.63 percent. The largest amount was eaten in July, when it occurred in 10 stomachs, or in about 1 stomach in 4½, and the average quantity for the month was 8.33 percent, thus approaching corn in importance. In August, 1 stomach in every 6 contained wheat, and the average for the month was 9.05 percent, slightly in excess of that for July. These two months, however, are the harvest months for wheat, and although the amount eaten at this season is naturally greater than at any other time, it does not follow that much harm is done, since the birds probably get very little grain except what has been shaken out during harvest. It is safe to assume that nine-tenths of all the wheat eaten by Crows is waste, the consumption of which is no loss whatever to the farmer. Stomachs taken in January contained only about 2 percent of wheat, and those in October not quite 3 percent.

Some observers say that Crows pull sprouting wheat in the fall as well as in the spring; but the damage thus done must be trifling, for very few complaints have been received.

OATS.

Oats occurred in 45 stomachs out of 909. The average quantity for the 45 stomachs is 30 percent, although the average for the year is 2.42 percent. Crows damage oats very slightly, since, as in the case of wheat, the grain eaten is for the most part waste. There is no increase in the quantity taken during harvest, and singularly enough the largest consumption of oats, as shown by the tables, is during the month of March, when the average reaches 7.88 percent. The next highest average is for August (3.75 percent), when 1 stomach in every 8 contained oats. The averages for February, April, June, and July range from 2 to 3 percent, and during the remainder of the year the amounts were less. The source of most of this grain is undoubtedly 'road pickings.' In other words, the supply is almost entirely derived from the droppings of horses and cattle. This fact, suspected long ago, receives ample confirmation from the presence in Crow stomachs of large quantities of coprophagous or dung-eating insects, and anyone who has carefully watched Crows in the fields knows with what regularity they avail themselves of this source of supply.

BARLEY.

Barley was not found except in the month of June, and occurred in two stomachs, in each of which it formed 80 percent of the contents, giving an average for that month of about 1 percent of the food.

BUCKWHEAT.

Buckwheat occurs with some frequency in Crow stomachs, but, doubtless owing to the fact that it is not widely cultivated, the proportion is very small. Only 17 stomachs out of 909 contained buckwheat, and the average for the year was less than 1 percent. Only in March was it present in sufficient quantity to be noticeable. In that month it formed a little over 5 percent of the entire stomach contents. This was due probably to the fact that the stomachs came from a region in which buckwheat happened to be abundant and the refuse seed was picked up in the fields soon after the snow melted. There is little to indicate that the Crow ever attacks growing or ripening buckwheat.

It is significant that among the various weed seeds picked up in small quantities by Crows species of the buckwheat family (*Polygonaceæ*) outnumber most other kinds. This probably is not due to any particular fondness for these seeds, but simply to the fact that they are abundant in waste places and most of them are shining black seeds of considerable size.

MAST.

About 6 percent of the total contents of Crow stomachs consists of mast—acorns, chestnuts, beech nuts, pecan nuts, and similar food. The order in which these items have been mentioned indicates their relative importance, but of the entire amount at least five-sixths is made up of the remains of acorns, while chestnuts and beech nuts form two-thirds of the remainder, and pecan nuts and palmetto nuts, occurring only in a few stomachs from Southern localities, make up the rest. Acorns in Crow stomachs reached their maximum in October, when they formed 15½ percent of the contents of the stomachs examined. In November the percentage fell to 9¾; in December to about 4, with a slight increase in January, while in February this average was doubled, and in March it reached almost 9½.

These figures naturally reflect the conditions of the food supply. In October most acorns ripen and fall, and the Crows easily obtain large quantities either directly from the trees or from the ground. By the middle of November few acorns are left upon the trees, and the fallen leaves have hidden part of those on the ground. In December and January snow usually covers the ground, and the supply of acorns must be obtained from places swept bare by the wind, from edges of streams, and springy places where the snow does not accumulate, or from the bare ground during occasional thaws. A large proportion of the Crow stomachs taken in December and January were collected during snowy weather, when such food must have been extremely hard to find. In February and March the melting snow again exposes the acorns, which are all the more acceptable from the fact that the cornfields have been so carefully gleaned already.

It is remarkable that in spite of the abundance of fruit and other soft vegetable food Crows continue to find and eat acorns all through the spring and early summer. The quantity eaten is small during most of this time, but some at least are found in every month except August, while in July the average exceeds 3 percent. This surely indicates considerable skill and diligence in hunting out the old acorns which have lain hidden so long. It is by no means impossible that Crows, in times of scarcity, draw upon hoards of food hidden by themselves or by other animals during seasons of plenty. Crows in confinement or in a state of semidomestication are notorious thieves, hiding everything for which they have no immediate use. In a wild state, too, they have been seen to carry off acorns in their bills, and at least some of these are presumably hidden or buried in the ground. This habit or instinct is common in some degree to most, if not all, members of the Crow family (*Corvidæ*), and in some of our American jays it is strongly developed.

Young Crows in captivity not only pull up corn on first sight, but some of them appear to have a veritable mania for pulling up any young growing sprout. During the summer of 1893 I saw a pet Crow spend nearly half an hour in attempting to root up a sturdy young oak of two years' growth, and failing in this he made similar ineffectual efforts to pull up the cane to which the little oak was tied to keep it straight. Finally, in apparent anger at its repeated failures, it began to pull off the leaves of the little tree, tearing them viciously and throwing the pieces aside. The same Crow made frequent visits to a piazza where were some potted plants, one of which he always pulled up, no matter how often it was replanted. After this had been repeated ten or twelve times the Crow carried away the plant, and it was never seen again.

GRASS AND WEED SEEDS.

Almost every Crow stomach taken in winter contained remains of grass or weed seeds. The quantity, however, was usually so small as to be entirely insignificant. It is only natural that a bird which gets almost all its food from the ground should pick up a few small seeds every day. In some cases considerable numbers of seeds were found in the stomachs, but in no case were they of great importance. The presence of seeds of various knotweeds (*Polygonum*) has been noticed already; next in abundance should be mentioned the bitter weed or ragweed (*Ambrosia artemisiæfolia*). The seeds of several other kinds of ragweeds also occur, notably the giant ragweed (*A. tridentata*). In addition to these a few stomachs contain seeds of amaranth (*Amarantus*), clover (*Trifolium*), mallow (*Malva*), foxtail grass (*Setaria*), and other grasses. Amaranth seeds are so universal and abundantly distributed in waste places that the few consumed by Crows can not have any effect in lessening the abundance of the weeds. The same probably is true of ragweed (*Ambrosia*), knotweed (*Polygonum*), and dock (*Rumex*). An examination of the castings of Crows at the roosts showed that a considerable number of seeds of the giant ragweed appeared to be indigestible and had been ejected with the other indigestible matter of which the castings are composed. It is possible that such seeds may not have lost their germinating power, but even in that case the number thus distributed would be small and the effect of no great importance. The average of grass and weed seeds for the year was less than half of 1 percent.

Fragments of seeds and a few seeds impossible to identify occurred in perhaps a dozen stomachs, but the total amount was only about one-fourth of 1 percent of the food for the year.

WILD RICE (*Zizania*).

Wild rice appears to be relished by the Crow, especially during winter, but the localities where it is available are limited. Almost all the stomachs containing wild rice were from Crows killed in the vicinity of Washington, D. C. Here are extensive wild-rice marshes, and at all times of the year the seed may be found on the mud flats or washed up along the banks of the Potomac. Before congregating at their nightly roosting places the Crows often assemble by thousands on these mud flats, and small flocks may be seen there at any time, picking up bits of food that attract their attention. It is doubtless at these times that most of the wild rice is discovered and eaten. It has, therefore, absolutely no significance from an economic point of view. All that is eaten is promptly digested, and the Crows therefore never distribute the seeds broadcast, as they do those of many small fruits and climbing vines. The average amount of wild rice in the stomachs for the entire year was 1 percent.

FRUIT.

The Crow is not generally regarded as a fruit eater, and the common verdict is fairly sustained by the evidence from the stomachs. About one-sixth of the food appears to consist of fruits, wild and cultivated, of which less than one-fourth is of any consequence to man.

Judging from the results of stomach examinations, the cultivated fruits most often attacked are grapes, cherries, strawberries, raspberries, blackberries, apples, pears, and watermelons, but from the nature of the case it is often impossible to say whether the remains are of wild or cultivated fruits. Apples and watermelons can be assumed to be cultivated, but of these fruits the Crow ordinarily takes the pulp only, and this is likely to escape detection in the stomach.

By considering the several fruits singly their relative importance, as well as the uncertainties attending the estimation of amounts, will be more readily appreciated.

Grapes.—Grapes were found in Crow stomachs only during the last five months of the year, and the quantity eaten in November and

December is insignificant. In August, however, it exceeds 9½ percent of the entire stomach contents; in September it amounts to almost 14 percent, and in October to 5 percent. Just what proportion of this fruit is cultivated it is impossible to say. Wild grapes are abundant in every section of country from which the stomachs came, and in many cases the seeds found were positively identified as those of the frost grape (*Vitis cordifolia*) and fox grape (*V. labrusca*), while other kinds were recognized more rarely. On the other hand, several Crows were shot while leaving vineyards of Concord grapes, and occasional complaints have been received from grape growers in different sections of the country. It is probable, however, that the Crow usually contents himself with wild grapes and is not likely to become a serious pest in vineyards.

Cherries.—In the case of cherries there is less likelihood of confounding wild and cultivated forms, since the seasons of ripening are usually different. In most localities cultivated cherries have ripened and disappeared before the wild species have begun to ripen. Moreover, the pits or stones of cultivated species usually may be identified with some degree of certainty. Nevertheless in many of the older settled parts of the country several varieties of introduced cherries have escaped from cultivation and now fruit abundantly in a wild state. This is the case in the Lower Hudson Valley, and most of the Crow stomachs collected in the vicinity of Sing Sing, N. Y., in June and July contained parts of such cherries. Reference to the table shows that in June and July at least 10 percent of Crow food consists of cherries, the larger part undoubtedly cultivated. It should be noted that from New Jersey southward, especially near the coast, the Fish Crow (*C. ossifragus*) is more or less abundant, and there is reason to believe that it is much more strongly addicted to fruit stealing than the common species. It is very similar to the Common Crow in general appearance, but is smaller (especially light in weight), with longer toes, and thus better fitted for arboreal feeding.

It is probable that at least half the damage attributed to Crows in the coast region of the Southern States is done by the Fish Crow, and as regards fruit eating, probably a much larger proportion should be charged to it.

Wild cherries, principally *Prunus serotina*, form an important item of the Crow's diet during August and September, and some are eaten during the latter part of July. The maximum, 6½ percent, is reached in August, and after September only an occasional cherry stone appears in the stomach contents. In addition to the species mentioned, remains of the small wild red cherry (*P. pennsylvanica*) were found in one or two stomachs, and stones of the choke cherry (*P. virginiana*) were not uncommon. One Crow, taken on Long Island, New York, had eaten beach plums (*Prunus maritima*).

Strawberries evidently are eaten freely by Crows, but owing to the indefinite number and small size of the seeds it is difficult to estimate the proportion in which they enter into the food. In June they form about 1 percent of the food, in July nearly 3 percent. During June and July the majority of stomachs examined contained remains of this fruit, but almost invariably these appeared to be wild berries. In a few instances cultivated berries had been eaten, and reports from several correspondents indicate that in rare instances considerable annoyance and loss may be occasioned by the Crow.

Blackberries and *raspberries* are noticeable in the Crow's diet only during July and August, and it is probable that most of the berries eaten are wild. Very few complaints of damage to cultivated blackberries or raspberries have been received, and it is doubtful if the Crows care enough for these fruits to lead them to pillage berry patches near houses. Unquestionable remains of raspberries are not common in the stomachs, and doubtless blackberries are most often eaten. Not only this, but it seems certain that the running blackberries, or dewberries, are most often taken, not because they are better flavored or more abundant, but because they are more accessible. As elsewhere stated, the Crow dislikes very much to alight in thickets, brush, or rank vegetation of any kind, and the high-bush blackberries are therefore almost inaccessible; they can not be reached from the ground, and the bushes are too slender and yielding to give support to so heavy and clumsy a bird; consequently the Crow contents himself with the low-running kinds or with the few high bush berries which chance to grow along fences or droop near the ground in places easily reached.

Apples are often eaten by Crows. Reference is not made here to the well-known habit of eating frozen apples which cling to the trees through the first half of the winter, but to attacks upon ripe or ripening fruit, particularly in August, September, and October. Remains of apples were not found in the stomachs as often as might be expected, but it should be remembered that unless the seeds or skin are swallowed it would be difficult to identify the source of fruit pulp that might be present, and in the case of juicy and tender apples very little pulp would remain undigested after the first half hour. On the other hand, the testimony of eyewitnesses is abundant as to certain specific instances of apple stealing, and in numerous instances seeds and skin were found. Reference to the table shows that in August nearly 4 percent of the stomach contents consisted of apples, in September about half of 1 percent, and in November almost 1 percent. In October no apple was positively identified in the stomachs, but it is noteworthy that more than half of 1 percent of unidentified fruit was found in October stomachs, and doubtless some of this was apple pulp.

An interesting note by F. C. Browne, of Framingham, Mass., appeared in Forest and Stream for August 25, 1880. Mr. Browne says: "A short time ago I happened to notice the almost daily visit of a small party of Crows to a certain tree in my apple orchard, and it occurred to me that the fruit might be the attraction, as it was a large, sweet, and tender variety. A visit to the tree proved my surmise to be correct. They had destroyed quite a number of apples by pecking out from a quarter to a half. When the stem would give way, the apple fell and another would be attacked. This may be nothing new, but in living on a farm constantly visited by Crows for nearly thirty years I have never had occasion to accuse them of this mischief before, though the indictment was strong enough without it."

Similar complaints have been received from other parts of Massachusetts, from Maine, Vermont, New York, and even from British Columbia.

Mr. Allan C. Brooks, of Chilliwack, British Columbia, writes: "Their worst offense is the destruction of apples. As soon as the salmon that ascend the river in the fall are all eaten, the Crows, which have congregated in immense flocks, attack the orchards in the vicinity. I have seen a fine orchard with seven-eighths of the apples broken into." The bird may have been the Northwest Fish Crow (*Corvus caurinus*) instead of the Common Crow.

In the fall of 1893 Mr. Clayton E. Stone, of Lunenburg, Worcester County, Mass., found the Crows eating Baldwin apples regularly, and samples were sent to the division for examination. On further investigation Mr. Stone found that the Crows visited the orchards in small parties, often in twos or threes, coming very quietly and usually early in the morning. So far as could be learned, no apples were carried away, but a great many were knocked off the trees, and many were pecked into and left to decay.

Several correspondents in eastern Pennsylvania and one in Virginia have known Crows to feed on pears, sometimes doing considerable damage.

Figs.—Crows are known to eat figs, but the evidence on this point is scanty at present. Very few stomachs were received from regions where this fruit is raised, and these contained no traces of figs. In California Mr. T. S. Palmer saw a flock of Crows feeding on figs at the Tejon Ranch, in Kern County, early in July. The birds frequented the orchard morning and evening, and several would often alight together on a tree and eagerly devour the ripening fruit. It was said that no small proportion of the crop was taken by Crows and other birds.

Crows are, however, comparatively rare in the southern part of the United States during summer, and this fact shows that such injuries are only local, and precludes the probability of any considerable loss on account of their fondness for figs.

Watermelons.—Complaints of injury to watermelons have been rather frequent, mainly from Kansas, Kentucky, Virginia, South Carolina, Georgia, Louisiana, and Texas, although there are enough from other States to show that the crop is likely to be attacked wherever grown.

The manner in which watermelons are pecked into without much of the pulp being eaten suggests the possibility that Crows attack this fruit mainly to satisfy their thirst, for all members of the Crow family are extremely fond of water.

Wild fruits.—With a few notable exceptions, the wild fruits eaten by Crows are of little consequence. Cherries, strawberries, grapes, raspberries, and blackberries have been mentioned already, and to these might be added huckleberries (*Gaylussacia*), blueberries (*Vaccinium*), Juneberries (*Amelanchier*), elderberries (*Sambucus*), both red and black mulberries (*Morus*), and in some localities barberries (*Berberis*) and bull berries or buffalo berries (*Shepherdia*). All these berries are more or less juicy and acid, and are taken commonly in small quantities. So far as our experience goes no one of them ever forms a large proportion of the Crow's food. Moreover, they ripen at seasons when other food is likely to be abundant, and excepting the barberry and bull berry none of them persist into the winter months. Certain other berries and small wild fruits, though apparently not more attractive in themselves, have the merit of clinging to the branches for a large part of the winter, and when other food is scarce the Crow resorts to them. Among these may be mentioned the poke berry (*Phytolacca*), Virginia creeper (*Ampelopsis*), holly (*Ilex*), haws (*Cratægus*), cedars (*Juniperus*), hackberry (*Celtis*), sour gum (*Nyssa*), cat brier (*Smilax*), and several species of *Cornus* and *Viburnum*, notably the flowering dogwood (*Cornus florida*). A few of these may be eaten at seasons when other food is plentiful, but ordinarily they are not touched until other sources of food supply become very scanty or fail entirely. In severe weather, or after unusually heavy or long continued snows, Crows are frequently found with their stomachs filled with the remains of poke berries, catbrier berries, and similar hard fare.

It is noticeable that the supply of these berries is very rarely exhausted, and yet in severe winters many Crows die at the roosts with every appearance of having starved to death.

Poisonous and harmless sumac.—Two other groups or genera of wild fruits should be mentioned, since they often serve to keep the Crow from starvation during snowy weather, while they form acceptable food at all seasons when obtainable. They are the sumacs (*Rhus*) and wax myrtle or bayberry (*Myrica*). The former genus comprises the harmless red-berried sumacs, the berries of which are decidedly acid and contain little nutritious matter, and the poisonous species *R. toxicodendron* and *R. venenata*, the berries of which contain considerable oily matter which apparently is very nutritious. As all these species of *Rhus*, poisonous and nonpoisonous, are widely distributed, very prolific, and their fruit strongly persistent, clinging to the bare twigs all through the winter, they furnish valuable food. This is particularly true of the poisonous species, the berries of which ordinarily are plumper and much richer in nutriment.[1] Crows eat all species of *Rhus*, and at all seasons, thus insuring the spread of these plants. The berries of the poisonous species are much preferred, and it is only as these become scarce that the harmless ones are much eaten. The average quantity of poisonous and harmless sumac berries consumed during the year is almost exactly the same, but most of the poisonous berries are eaten during late summer, autumn, and early winter, while most of the harmless berries are eaten during midwinter and toward spring, as shown by the following table:

Table showing percentages of sumac berries in Crow stomachs from August to April.

	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Average for the year.
Harmless sumacs	......	......	......	4	5	6.58	9.96	0.89	0.74	2.27
Poisonous sumacs	0.5	3.4	8.46	6	4	3.89	.56	......	......	2.24

After eating these berries the Crow rapidly digests the nutritious pulp and ejects from the mouth the seeds, together with the sand swallowed to aid in digestion (see fig. 1). The subject of the winter food of Crows, as shown by the material found at the roosts, has already been discussed (see pages 21–24). It is only necessary to add that the seeds are not at all harmed by digestion of the surrounding pulp, and after expulsion from the stomach are in good condition to grow. By actual experiment it was found that more than 90 percent of such seeds germinated when planted.

In one case 153 seeds of poison *Rhus* were taken from a single Crow stomach in addition to much other food, and in numerous instances stomachs were found to contain from 90 to 130 of these poisonous seeds.

A caged Crow, well fed on grain and some animal food, ate poison-ivy berries whenever offered, although he refused berries of the smilax and those of the harmless red-berried sumacs unless very hungry. After eating 50 or more berries of the poison *Rhus* this Crow ejected the seeds, perfectly clean and devoid of pulp, in rather less than forty minutes, after which he was willing to eat more berries. These facts indicate that under ordinary circumstances a single Crow might distribute several hundred seeds of poison *Rhus* in the course of a day, with a fair prospect that many, if not most of the seeds, would germinate and live.

The bayberry or wax myrtle (*Myrica cerifera*) is an abundant shrub along the Atlantic Coast from Maine to Florida, but its range does not extend inland very far, except in the neighborhood of the St. Lawrence River and lakes Ontario and Erie. The berries or fruits have a waxy pulp similar to that surrounding the seeds of the poisonous *Rhus*, but richer in waxy or oily matter. Crows appear to like this fruit very much, and the stomach examinations show that in August and September it formed rather less than 1 percent of their food, increasing to 1½ percent in October, and exceeding 4 percent in November, after which time it did not appear in the stomachs. The shrub is well known as a harmless, aromatic bush of no particular importance, but the fruit was formerly used in the manufacture of wax for candles, whence it received the name of candleberry, by which it is still known in some places.

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[1] *Rhus venenata*, the most poisonous species, is known as poison sumac, poison elder, poison dogwood, and swamp dogwood, while *Rhus toxicodendron* is variously known as poison ivy, poison oak, poison creeper, and poison vine.

CHAPTER V.

PROTECTION OF CROPS.

The early settlers of New England and Virginia were confronted with the problem of protecting their crops from Crows and blackbirds, and from that time until the present the farmers of the eastern United States have been compelled annually to meet the same enemies to grain. Naturally the first attempt at protection looked toward the extermination of the offending birds, pending which the crops were guarded as well as possible by watchers (ordinarily children) or by 'scarecrows' and other devices intended to frighten the birds away. Precisely the same methods had been pursued for centuries in the Old World and are still in use in our own country. The efforts of the early colonists were comparatively fruitless, owing partly to the small area of cultivated land and partly to the lack of adequate means of destruction, such as breech-loading guns and cheap poisons. To encourage the destruction rewards were offered in many towns, while in others each head of a family was compelled to kill a certain number of Crows or blackbirds yearly; in case of failure a fine was imposed proportioned to the number lacking. "The records of the different towns show that large sums were often paid in premiums for the destruction of Crows and blackbirds. * * * In Norwich, Conn., early in the eighteenth century a half-penny a head was paid for every blackbird or Crow killed in the town, and though the amount offered was so small, it is stated that it formed a considerable item of expense to the town."[1]

That such persecution was not without effect is a matter of history, and the same writer goes on to say: "The traveler Kalm relates that Dr. Franklin told him in 1750 that in consequence of the premiums that had been paid for killing these birds [Crows and blackbirds] in New England they had become so nearly extirpated that they were very rarely seen and in few places only. In consequence of this exterminating warfare on the 'maize thieves,' the worms that preyed upon the grass increased so rapidly that in the summer of 1749 the hay crop was almost wholly cut off by them, the planters being obliged to bring hay from Pennsylvania, and even from England, to Massachusetts to meet the deficiency caused by the worms." It should be noted, however, that the statement as above quoted is not precisely as Kalm wrote it. He was careful not to state that the worms increased as a consequence of killing the birds, but only that the people believed that to be the case.

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[1] J. A. Allen, The Penn. Monthly, December, 1876, pp. 941–942.

His words are: "But as, in the summer of the year 1749, an immense quantity of worms appeared on the meadows, which devoured the grass, and did great damage, the people have abated their enmity against the maize thieves, for they thought they had observed that those birds lived chiefly on these worms before the maize is ripe, and consequently extirpated them, or at least prevented their spreading too much."

It is to be presumed that such invasions of insects had a wholesome effect in checking the too general slaughter of the birds, and it is probable that thereafter the colonists contented themselves more largely with efforts to frighten the birds away from their crops.

It is unnecessary to describe the various methods resorted to. The use of 'scarecrows' was perhaps the most common, but unless Crows were less intelligent than at present this method could not have been effective for any length of time. Small windmills, so adjusted as to turn watchman's rattles or otherwise make loud noises, were often used, and also benches of jingling tins and sheet iron, suspended from poles and moved by the wind. Single Crows were shot and hung up as a warning to the rest, and in some cases doubtless served the purpose intended. One of the commonest means employed was to encircle each field with a white string, supported at intervals on poles of various heights, and, in case the field was large, crossing it several times with the string. In many cases this simple measure was sufficient to keep the Crows off altogether, doubtless because they suspected that the string was part of a system of snares. This plan, somewhat modified, is still used in many parts of the country, and is more or less efficacious. By crossing fields in two directions with strings, so as to form a network, even though the meshes are many yards in diameter, complete protection from Crows can be secured, but there are better ways—ways requiring less time and expense.

TARRING CORN.

For many years it has been known that Crows, blackbirds, and bobolinks or rice birds dislike the flavor of tar of any kind, and in many parts of the country advantage of this fact has been taken to prevent the pulling of corn and other grain after planting. Each kernel of seed grain is more or less completely covered with tar, or some preparation of tar, so that the flavor is imparted to the kernel and is not lost entirely for several weeks. In fact, it is found that in shoots of rice which grow from seed thus treated the flavor of the tar can be detected plainly until the green blades are 8 or 10 inches high and too strongly rooted to be easily pulled up by birds.

Just when and how this important discovery was made is not known, but the practice of tarring seed corn before planting has been in common use in Maryland and Virginia for nearly or quite a century, and it is rather remarkable that it has not been adopted in all parts of the country where Crows are troublesome. The earliest reference to it, so far as we know, occurs in Dr. John D. Godman's 'Rambles of a

Naturalist,' published in 1833. Dr. Godman's account of the Crows' attacks on the newly planted corn and the method of preventing serious damage is so interesting that it is given almost entire. He says: "Woe betide the cornfield which is not closely watched, when the young grain begins to shoot above the soil! If not well guarded, a host of these marauders will settle upon it at the first light of the dawn, and before the sun has risen far above the horizon, will have plundered every shoot of the germinating seed, by first drawing it skillfully from the moist earth by the young stalk, and then swallowing the grain. The negligent or careless planter, who does not visit his field before breakfast, finds, on his arrival, that he must either replant his corn or relinquish hopes of a crop; and without the exertion of due vigilance he may be obliged to repeat this process twice or thrice the same season. Where the Crows go to rob a field in this way they place one or more sentinels, according to circumstances, in convenient places, and these are exceedingly vigilant, uttering a single warning call, which puts the whole to flight, the instant there is the least appearance of danger or interruption. Having fixed their sentinels, they begin regularly at one part of the field, pursuing the rows along, pulling up each shoot in succession, and biting off the corn at the root. * * *

"Numerous experiments have been made, where the crows are thus injurious, to avert their ravages; and the method I shall now relate I have seen tried with the most gratifying success. In a large tub a portion of tar and grease were mixed, so as to render the tar sufficiently thin and soft, and to this was added a portion of slaked lime in powder, and the whole stirred until thoroughly incorporated. The seed corn was then thrown in, and stirred with the mixture until each grain received a uniform coating. The corn was then dropped in the hills, and covered as usual. This treatment was found to retard the germination about three days, as the mixture greatly excludes moisture from the grain. But the Crows did no injury to the field; they pulled up a small quantity in different parts of the planting, to satisfy themselves it was all alike; upon becoming convinced of which, they quietly left it for some less carefully managed grounds, where pains had not been taken to make all the corn so nauseous and bitter."

Dr. Godman saw this method used in Anne Arundel County, Md., probably about the year 1800, and essentially the same plan is still in use in the same vicinity. In neighboring States tar in some form—coal tar, gas tar, or wood tar—is used with equally good effect.

Mr. Marcus S. Crane, of Caldwell, Essex County, N. J., describes the method practiced in his vicinity as follows: "Most farmers in this section have adopted the coal-tar method, viz: Before planting, a half bushel or more of corn is put in a vessel, slightly moistened with warm water, and enough coal or gas tar dropped in to give each kernel a thin coating when stirred; after this, plaster of paris is stirred in until the corn is nearly white. When this plan is used, Crows will not injure corn after they pull a little and find what is on it."

Mr. J. V. Henry Nott, of Kingston, N. Y., says: "I soak the seed over night, and after draining off the water thoroughly, stir the tar in it by dipping a small stick in the tar and vigorously stirring the seed with it until all is a brown color, after which I stir in plaster until the seed looks like sugar-coated pills. The only objection is that a planter can not be used."

Hon. C. L. Merriam, of Locust Grove, Lewis County, N. Y., writes: "Last year my farmer planted an 11-acre lot with corn, but being out of sight the Crows took it all. This year he poured the seed corn into tar oil, didn't soak it, but took it out and rolled it in wood ashes, and then planted it. Crows opened two hills, didn't like the taste or smell, and let the rest alone. Persons who have soaked corn in tar oil say it kills the germ."

The objections usually raised to the 'coal-tar method' are three: (1) It retards germination; (2) it renders the seed corn so sticky that it must be planted by hand instead of by a planter; (3) it is too much trouble to prepare and plant the seed in this way. The last objection naturally is unanswerable, but the first can be easily overcome by soaking seed for a short time before coating with tar. In this way the growth of the germ is started by the moisture absorbed and the seed will continue to swell and sprout.

As to the use of a mechanical planter, there is little doubt that the difficulty can be overcome by careful experiments. Air-slaked lime, ashes, powdered earth, or any fine dry powder can be used as an absorbent in place of plaster of paris, and with a little extra care no difficulty should be found in using the planter. It is more than probable that some preparation of tar could be made which would not be sticky and yet carry all the qualities offensive to birds. Tar oil is effective, and very likely creosote, or even crude carbolic acid properly diluted would be equally so. This line of experiment is suggested as a promising one for some experiment station favorably situated.

USE OF POISON.

In some parts of the Eastern States, Crows have been poisoned in considerable numbers. It is an easy matter to poison a few Crows, but the general disappearance which so often follows the use of strychnine must be attributed mainly to the Crows' intelligence; the mysterious death of a few serving as a warning to the many survivors, who promptly quit the locality. This fact has been repeatedly observed. Dr. Charles E. McChesney states: "At Fort Berthold, N. Dak., where I observed it in numbers in the spring of 1873, doing much damage to the young corn and other parts of the crop, it was quickly driven from the vicinity by poisoning corn and sprinkling it around the scene of their operations, and although only a few dead birds were discovered, the survivors took the hint and left for a more agreeable abode."[1]

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[1] Bull. U. S. Geol. and Geogr. Surv. Terr. V, No. 1, 1879, p. 80.

George C. Benson, of West Belleville, Ill., writes: "We used to kill rabbits, salt them well with arsenic, and tie them on some fence stake with wire; the Crows would get their flesh and take some to their young, and then for years no Crows would alight in our fields."

Dr. W. C. Brownell, of Plymouth, Mich., wrote in 1891: "As an experiment I soaked 1 pound of common dent corn for several days (two or three, I have forgotten which) in a solution of *Hyoscyamus niger* (homeopathic tincture) and water. When the corn began to swell, I dried out the excess of liquid and mixed the corn in some fine horse manure and took the whole into a pasture lot near a dead sheep where I knew the Crows came every day. Several days later I found four dead birds in a grove half a mile distant, and the Crows never came back to the sheep."

Incidents like these show how readily the Crow may be frightened away by the use of poison, even when comparatively few are killed. Several correspondents have stated that sprouting corn may be protected by strewing good corn on the surface of the ground. One person writes from Mount Carmel, Mo.: "Young corn may be effectually protected by feeding the birds boiled corn or soaked corn, sown broadcast, 2 quarts to 10 acres. The damage to matured crops is inconsiderable in this locality."

Another writes from Bucks County, Pa.: "Samuel Hart, of Doylestown, protects his cornfield every spring against Crows by simply scattering some loose grain every day around his entire field of 10 acres; every other day will answer, provided the supply is not exhausted. This method has been practiced with entire success for many years, and though Crows are very numerous no corn is pulled up. The entire cost, as estimated by Mr. Hart, is the time required and a total of half a bushel of corn."

BOUNTIES.

As previously stated, bounties were resorted to by the earliest settlers of the country in their efforts to lessen the numbers of Crows and blackbirds. Apparently the plan was moderately successful. Nevertheless, then as now the offer of a bounty for the heads of any undesirable species proved a severe tax on the people who paid it, and whenever the abatement of the evil warranted it the bounty was at once withdrawn. Even when the bounty was very small—not more than 1 cent (a halfpenny) per head—the sums required to pay the rewards became so great that in many instances the repeal of the laws became necessary, and it was found better to compel each citizen to kill a specified number of blackbirds or Crows each year.

Dr. Godman, already quoted, states that "about the years 1800–1804 the Crows were so vastly accumulated and destructive in the State of Maryland that the Government, to hasten their diminution, received their heads, in payment of taxes, at the price of 3 cents each. The storekeepers bought them of the boys and shooters who had no taxes to pay, at a rather lower rate, or exchanged powder and shot for them. This measure caused a great havoc to be kept up among them, and in a few years so much diminished the grievance that the price was withdrawn."

At intervals, however, bounty laws have been revived in Maryland, Virginia, Pennsylvania, and in fact in nearly all the Eastern States, and when the State did not pay a bounty, in very many cases counties or towns did so, with the result that in one part of the country or another the Crows were always subject to persecution. Even at the present time bounties are paid in many parts of the United States, sometimes for Crows alone, more often for various birds and animals which, with or without reason, are believed to be pests.

In December, 1890, Mr. Robert C. Alexander, of Stark, Wayne County, Mich., wrote as follows to the Department: "For the last four years (1887–1890) this town has given a bounty of 10 cents a head on woodchucks (*Arctomys*), Crows, and all species of hawks, and 5 cents a head on the common gopher (*Spermophilus 13-lineatus*) and the common mole (*Scalops aquaticus*). This has taken about $100 out of the treasury each year, and as far as I can see it has not decreased the numbers in any case. Last year the Crow was more abundant than it has been before in a great many years."

Dr. W. C. Brownell, of Plymouth, Sheboygan County, Mich., wrote in 1891: "Several townships in this immediate vicinity offer a bounty on heads and eggs, with the result of large numbers of Crows being killed and many nests broken up."

In 1889 the legislature of Maine enacted as follows:

> SECTION 1. A bounty of ten cents for every Crow killed in any town in this State between the thirty-first day of March and the first day of November of each year, shall be paid by the treasurer thereof, to the person depositing (in lots of ten or more) the heads of the same with such treasurer. The treasurer shall immediately destroy such heads.
>
> SEC. 2. Towns shall be reimbursed from the State treasury, etc.

One thousand dollars was appropriated by the legislature for the payment of bounties in 1889 and a similar amount for 1890. At the close of 1889 it was found that $2,200 would be required to pay for Crows already killed, and it may well be doubted whether the number of Crows in the State had been perceptibly diminished.

The number of Crows gathering nightly at an average winter roost in Maryland or Virginia certainly exceeds 100,000, and many roosts are known to accommodate double that number. The Maine law wisely limited the bounty to Crows taken during spring, summer, and autumn, and thus probably was doubly effective; yet it is doubtful whether any State east of the Mississippi is able to pay 10 cents each for all the Crows which nest within its boundaries. As a matter of fact, it is certain that not more than half the Crows could be killed by the offer of such a bounty, and so soon as the survivors became too wary to be easily secured their pursuit would be generally abandoned and the species would reestablish itself.

It seems probable that in most places the Crow is neither so harmful nor so valuable as to render special laws necessary for its destruction or protection, but from a purely economic standpoint the attempt to rid a State of Crows by bounties or any other means must prove either a complete failure or a most expensive success.

APPENDIX.

LIST OF LOCALITIES AT WHICH CROW STOMACHS WERE COLLECTED.

	Number of stomachs.	
Alabama:		
Greensboro	4	
Hale County	1	
		5
California:		
Visalia		1
Connecticut:		
East Hartford	23	
Portland	7	
Rockville	1	
		31
Delaware:		
Cheswold	2	2
District of Columbia:		
Brookland	11	
Washington	136	
		147
Florida:		
Fort Drummond	1	
Micco	1	
		2
Georgia:		
Calhoun		1
Illinois:		
Jacksonville		1
Indiana:		
Argos	1	
Farmland	14	
Waterloo	1	
		16
Iowa:		
Boone County	2	
Gilbert Station	2	
Sabula	3	
Scott County	8	
		15
Kansas:		
Onaga	27	
Zarah	2	
		29
Kentucky:		
Union County	6	6
Maine:		
Clinton	17	
Gorham	2	
Winslow	1	
		20
Maryland:		
Aikin	2	
Easton	5	
Marshall Hall	1	
Montgomery County	312	
Principio Creek	1	
Seabrook	1	
		322
Massachusetts:		
Amherst	1	
Raynham	2	
Wilmington	1	
Worcester	2	
Lunenburg	7	
		13
Michigan:		
Livonia	2	
Redford	1	
Wayne County	29	
		32
Missouri:		
St. Louis		1
Montana:		
Bozeman	2	2
Nebraska:		
Everett	6	6
New Jersey:		
Alton	1	
Englewood	1	
Horse Hill	1	
Morristown	5	
Wigger Pond	2	
Pecks Island	1	
Schraalenburg	2	
Vineland	1	
		14
New York:		
Alder Creek	2	
Alfred Center	18	
Broadway	1	
Buffalo	2	
Chautauqua County	2	
Hammondsville	1	
Lake George	1	
Lake Grove	1	
Peterboro	5	
Rockaway	3	
Selden	1	
Shelter Island	6	
Sing Sing	15	
Smithboro	1	
Watkins	2	
Westerville	34	
Winfield	1	
Youngs	7	
		103
North Dakota:		
Fort Buford	4	4
Ohio:		
Austinburg	4	
Mount Airy	1	
New Concord	1	
Oxford	14	
		20

	Number of stomachs.	
Oregon:		
Creswell		1
Pennsylvania:		
Beaver	9	
Berwyn	1	
Chester County	4	
Ercildoun	1	
Fallston	1	
Herrick	4	
Lower Providence	1	
Montgomery County	2	
Vanport	1	
	——	24
South Dakota:		
Vermillion	4	4
Tennessee:		
Warner	3	3
Texas:		
Eastland		1
Vermont:		
Essex Junction	1	
Manchester Center	2	
Rutland County	30	
	——	33
Virginia:		
Alexandria	18	
Drewrys Bluff	20	
Gainesville	2	
	——	40
Wisconsin:		
Bears	1	
Darien	1	
Delavan	1	
Oregon	3	
	——	6
New Brunswick:		
Hillsboro	4	4
		——
Total		909

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